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Conseil Permanent International pour l'Exploration de la Mer

CHARLOTTENLUND SLOT – DANEMARK

RAPPORTS

ET

PROCÈS-VERBAUX DES RÉUNIONS

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Volume 143

Part I

CONTRIBUTIONS TO SPECIAL HERRING MEETINGS 1956

On the Herring of the Southern North Sea

En Commission chez

ANDR. FRED. HØST & FILS

COPENHAGUE

Prix: Kr. 10.00

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[1]) The full paper will appear in M.A.F.F., Ser. 2, 20 (11).

Introduction

Recently there has been a disturbing tendency in the herring fisheries of the Southern North Sea (especially East Anglia) with markedly decreasing yields and catch per unit of effort. This development has been intimately studied by English scientists, and as a result of their inquiries fear is expressed that the altered situation cannot be satisfactorily explained as due to natural causes only. This conclusion introduces a new aspect in the herring fishery in European waters, and confronts, if valid, the research workers with a new set of problems. The fish stock in question, the "Downs Herring", is fished by many different nations and at varying locations and times. Consequently, an international meeting of herring experts was called on the initiative of the English fishery research workers to discuss thoroughly the situation of the herring stock of the southern North Sea. The meeting was held under the auspices of ICES as a special scientific meeting in this organization's Herring Committee. As Chairman of this Committee I want to extend my best thanks to the contributors to this report, to all those taking part in the discussion, and to Mr. F. R. Jones who acted as Reporter during the meeting.

Although the "Lowestoft thesis" was not refuted on any point during the meeting and substantially accepted as a fair explanation of recorded facts, the meeting did not consider the presented evidence as conclusive. This will be apparent from the resolution passed by the meeting (the wording to be found in "Summary of Proceedings"). It is of course true that the different nations are competitors insofar that they exploit the same stock, but nevertheless their interests are intimately linked when the question arises to preserve the common source of supply. To any intelligent management a sound knowledge of the state of affairs will be of prime importance. It is therefore very encouraging that so many of the interested Governments have agreed to finance a co-ordinated research programme in order to close the gaps in knowledge. With the implementation of this programme history will be made in herring research.

Olav Aasen

Summary of Proceedings

THE Special Meeting on the Herring of the Southern North Sea was held at Charlottenlund Slot, Copenhagen, on 28. September. After opening remarks by the Chairman in which two new members of the Herring Committee, the USSR and Poland, were welcomed, the meeting continued with papers presented by:–

1. J. ANCELLIN: "Considérations sur les Harengs du Sud de la Mer du Nord et de la Manche Orientale."[1])
2. J. J. ZIJLSTRA: "The Catch per Unit of Effort of the Dutch Drift-Net Fisheries in Different Regions of the North Sea in the Period 1947–1955."
3. B. B. PARRISH, & R. E. CRAIG: "Recent Changes in the North Sea Herring Fisheries."
4. D. H. CUSHING, & A. C. BURD: "On the Herring of the Southern North Sea."[2])
5. CH. GILIS: "Evolution dans le Temps et dans l'Espace de la Composition des Concentrations de Harengs exploitées par les Pêcheurs Belges dans la Mer du Nord au cours de la Période 1951–1955."

After the presentation of the papers, there was a recess to allow members to study the details of the contributions to prepare for the discussion, the background of which was the recent decline in the East Anglian November Herring Fishery, which according to CUSHING and BURD, could only partly be ascribed to natural causes.

In the discussion other fishing regions were covered by contributions from other members, in particular from Dr. SCHUBERT, Dr. MARTY, Dr. HÖGLUND, and Dr. ZIJLSTRA. Dr. SCHUBERT dealt mainly with the central North Sea and his main conclusion was that the changes observed in this area could be ascribed to natural causes and that the German view was that there had been no decline in the herring stocks in this part of the North Sea. He suggested that the herring stocks might be involved in a northward displacement and that this might especially affect the older herring.

Dr. MARTY referred to Russian experience from widely distributed areas where there had been observed declines in the yield of the herring fisheries, and he concluded that this was due to a decline in the older age-groups as a result of fishing, thus substantiating CUSHING and BURD's view that a high level of fishing might, to a marked extent, affect the abundance of older fish.

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[1]) See Part II of this volume.
[2]) Printed *in extenso* in Min. Agric. Fish. & Food, Fish. Invest., Ser. 2, **20** (11). 1957.

Dr. Höglund stressed the close relationship between the Skagerak winter herring and the Fladen trawl fishery and produced histograms to illustrate his views. Although he could not claim his samples to be fully representative, his impression was that the apparent decline in the abundance of the older year-classes after 1953 might be due to good recruitment.

However, Dr. Zijlstra pointed out that according to the Dutch investigations on the August-October fisheries in the central North Sea, the catch per unit of effort had fallen from 1954 to 1955 and that there was a suggestion of a further decline this year.

Dr. Wood pointed out that on the Fladen and Gut during the summer fishery there was a stock of older herring being exploited by various nations to a considerable extent and furthermore that the Scottish tagging experiments had shown a general southerly movement of these herring, and he indicated that the heavy exploitation of the older year-classes might have an effect on the abundance of these year-classes in the southern North Sea.

Professor Bückmann probed the question of what connexion might possibly exist between alterations in the central and southern North Sea. He suggested that this might be linked with hydrographic conditions. On this point Dr. Cushing asked for evidence to show that hydrographic changes were related to the fall in catch per unit of effort in the East Anglian fishery in November.

The discussion then turned to deal more especially with problems relating to the southern North Sea herring fishery. Professor Bückmann expressed the view that he was impressed by the evidence presented by Cushing and Burd but stressed the point that caution should be exercised not to overburden the evidence from landing and sampling statistics by two comprehensive conclusions, giving as an example his own investigations into the plaice. He did, however, also point out that his remarks were not to be considered as a criticism of the English approach but only as a warning. Dr. Cushing said that he considered Dr. Hodgson's successful forecasting in the East Anglian fishery for 19 years to be an index of the reliability of the English sampling methods and that when the forecast failed in recent years they were able to pin-point the natural cause partly responsible for it. Taking into consideration Mr. Parrish's view on the importance of availability he agreed with Prof. Bückmann's word of caution.

Dr. Cieglewicz presented statistical data from the Polish fishery investigations in the Downs herring in 1954 and 1955, this evidence showed both for drifters and trawlers that there had been a decline in the catch per unit of effort. There was an indication that the decline was continuing this year.

After further discussion between various members Dr. Cushing produced three regressions of mortality and effort. From these regressions estimates of natural mortality could be made which were in good agreement for the three methods, approximately 0.2. Further evidence from the Belgian spent-herring fishery during the war years gave an estimate of 0.27. Dr. Cushing considered this to be close to the natural mortality because of the low level of fishing. If there had in recent years been an emigration of older fish from the Downs stock to the north, one would expect that the estimates of natural mortality derived from his regressions to be greater

than that derived from the Belgian spent fishery. As this was not the case he concluded that emigrations had not taken place. From his regressions Dr. CUSHING further concluded that the increase in effort had in fact raised the total mortality (F + M) thus showing the effect of fishing.

After a discussion arising from details of CUSHING and BURD's paper, Mr. HOLT went on to say that there were different methods of dealing with the vital statistics and that it would be worth while to look further into this question. Dr. LUCAS expressed as his view that there should be co-ordinated efforts to close the gaps in the detailed knowledge.

This remark led the discussion into the final considerations and the Chairman to sum up the discussion by stating that although there were, on several points, a considerable measure of agreement, Dr. LUCAS' view concerning the lack of adequate information was undoubtedly correct and asked the Committee if anyone would venture to suggest a definite proposal for the advancement of closer international co-operation in order to clear up the uncertain points.

Dr. VEDEL TÅNING then put forward a draft in two parts which was approved in the following form:–

1. This Committee views with concern and apprehension the present state of the stocks in the Southern North Sea Herring Fishery.
2. This Committee wishes to draw the attention of member Governments to this concern and would urge all interested countries to co-operate in a co-ordinated programme designed to determine the relative magnitude of the various factors affecting the yield from the southern North Sea and indeed all other North Sea Herring Fisheries. They have particularly in mind the urgent need for adequate effort statistics from all countries, together with an intensive tagging programme.

This resolution was later (3.X.56) considered in the Herring Committee's business meeting and passed as a recommendation which subsequently was adopted by the Council.

OLAV AASEN, F. R. JONES

1.

The Catch per Unit of Effort of the Dutch Drift-Net Fisheries in Different Regions of the North Sea in the Period 1947–1956

By J. J. Zijlstra

Recent concern about the herring stock of the southern North Sea have led us to consider the catch per unit of effort of the Dutch drift-net fisheries in this area since the war. As probably the catch per unit of effort depends mainly on the size of the stock we may expect to get a picture of the abundance of the herring in the course of the period 1947—1955.

One of our aims was to compare the Dutch data of the southern North Sea with those of the very similar East Anglian fishery, published recently by Cushing and Burd (1957).

In addition we compared the catch per unit of effort of the Dutch drift-net fisheries in different regions of the North Sea.

In 1953 Havinga showed data of the Dutch drift-net fisheries, together with data of the herring trawl fishery. He considered the question whether signs of overfishing could be detected and concluded from his data that this was not the case. For the drift-net fisheries he showed the mean catch per shot in "kantjes" for each year and month apart, in the period 1947—1952.

In this paper too the catch per unit of effort will be expressed in the mean catch per shot in "kantjes", in which a kantje represents about 90—93 kg. This means that the catch per unit of effort may be used as a measure of the abundance of the herring in terms of weight. Unfortunately no data were available to transform this weight measure in terms of numbers of fishes, as has been done by Burd (1957).

For his calculations Havinga used the average data given in the herring charts published in the *Annales Biologiques*. The figures shown here have been calculated from the original data and consequently more accurate estimates might be expected.

The data of the catches per unit of effort (unit shot in "kantjes") of the Dutch drift-net fisheries in different regions of the North Sea are shown in Tables 1—5.

Table 1. The area between 51° and 53°30′N., from October till December

	Year								
	1947	1948	1949	1950	1951	1952	1953	1954	1955
October	71	74	43	113	69	100	49	120	53
November	83	70	77	57	57	59	61	65	38
December	34	12	23	27	36	19	54	13	19
Period Oct.-Dec.	68	66	64	78	58	77	55	90	42

This is the region of the English East Anglia fishery, where one of the most important Dutch drift-net fisheries takes place. The herring caught is mainly in pre-spawning and spent condition.

Table 2. The area between 53°30′ and 56°N., in September and October

	Year								
	1947	1948	1949	1950	1951	1952	1953	1954	1955
September	47	48	31	34	36	38	33	30	25
October	70	35	33	41	33	76	23	74	41
Period Sept.-Oct.	56	45	32	35	35	44	30	31	31

In this area spawning takes place in September and October, on different grounds (Whitby, Dogger, Berwick coast). The catch per unit of effort may thus give a picture of the abundance of the spawning stock in the area, although an admixture of herrings belonging to other stocks and not being in spawning condition, may be included in the catches in this area.

Table 3. The area between 55° and 57°N., from May till July

	Year								
	1947	1948	1949	1950	1951	1952	1953	1954	1955
May	—	13	17	—	14	8	—	2	8
June	36	17	6	8	17	13	27	15	34
July	23	27	14	17	21	33	36	30	31
Period May-July	32	23	13	12	17	26	32	22	31

This area may be considered to be the southern summer feeding ground of the North Sea herring.

Table 4. The area north of 57°N., from May till July

	Year								
	1947	1948	1949	1950	1951	1952	1953	1954	1955
May	—	15	16	—	11	21	—	17	19
June	36	14	11	10	16	26	19	10	45
July	33	31	12	27	21	31	25	14	41
Period May-July	33	16	12	18	16	27	19	12	43

This region represents the northern summer feeding area. In general it is the same ground as the Buchan grounds of the Scottish drifter fleet.

Table 5. Total North Sea and English Channel

	Year								
	1947	1948	1949	1950	1951	1952	1953	1954	1955
Period May-Dec.	48	41	29	41	38	45	41	47	38

Finally the mean catch per unit of effort of the Dutch luggers, fishing with drift-nets, is given for the whole year for the North Sea and the English Channel.

The Dutch data of the southern North Sea stock are given in Table 1. These data might be compared with those of the East Anglian fishery of the English and Scottish drifter fleets, given by CUSHING and BURD (1957). A difficulty is met here, because our data are expressed in a weight measure, while in most of the English data the numbers of herrings per unit landing are given. Only from Table 2 of BURD's paper (Part III) the mean catch per landing in crans for the whole East Anglian fishery can be calculated. Comparing these figures with the Dutch data we get:—

	Year								
	1947	1948	1949	1950	1951	1952	1953	1954	1955
	(crans per landing)								
English data ...	49	48	48	47	43	44	40	49	24
	(kantjes per shot)								
Dutch data	68	66	64	78	58	77	55	90	42

These two sets of data, derived from two very similar fisheries show relatively little agreement. The English figures show a more or less gradual decline from 1947 to 1955, except for the last two years; the Dutch data, on the other hand, show increasing fluctuations. To evaluate the trend in the catches for both fisheries the mean catch per effort for the periods 1947—1950 and 1951—1955 were compared. The mean catch per landing for the English fishery was 48 and 40 crans respectively, for the Dutch fishery these figures were 69 and 64 kantjes per shot. This means a decrease of 16.5 % for the English fishery and a decrease of 7 % for the Dutch fishery. For both fisheries, but especially for the Dutch, the poor catches in 1955 are of great importance for the reduction in the mean catch per unit effort in the period 1951—1955, compared with 1947—1950.

The English and Dutch data agree in that the November catches, rather than the October catches, show a reduction. Comparing again the periods 1947—1950 and 1951—1955 for the Dutch fishery, the October catches are found to be 75 and 78 kantjes per shot, the November catches 72 and 56 kantjes. Thus the October catches, consisting mainly of young herring, according to HODGSON, have increased by 5 %, but the November catches have decreased by 22 %. The English figures expressed in numbers of fish per unit landing, show a decrease for both months, although the reduction of the catch per effort in November is much more serious (37 %) than in October (5 %). Again the English data show a more serious reduction in the catch per effort than the Dutch. However, as the Dutch data are expressed in weights and the English in numbers of fish it is likely, that the differences here are at least partially due to the faster growth-rate of the herring since 1951 (ANCELLIN, CUSHING). This faster growth-rate would tend to increase the weight of a given number of fishes and therefore a weight measure will probably give a too high estimate of abundance compared with a measure by numbers of fishes.

In general we may say that the Dutch data of the drift-net fishery in the southern North Sea (East Anglian fishery) give a less pessimistic picture than the English data. This might be due to the fact, that the fishing areas of the English and Dutch herring fleets are not exactly the same.

Tables 2—4 give data of the catch per unit of effort in other areas of the North Sea. In order to get a general idea about the trend of the catch per effort in these areas the two periods 1947—1950 and 1951—1955 were again compared. This was also done for the catch per unit of effort of the whole North Sea (Table 5).

Area	1947—1950	1951—1955
	kantjes per shot	
Central North Sea ..... Sept.-Oct. (Table 2)	42·0	34·2
Central North Sea ..... May-July (Table 3)	20·0	25·6
Northern North Sea..... May-July (Table 4)	19.8	23·4
Total North Sea..... All months (Table 5)	39·8	41·8

The total of the Dutch drift-net fisheries show a small rise in the catch per unit of effort in the period 1947—1955. This rise seems to be due to an improvement of the catches in the summer fisheries. Both summer fisheries on feeding herring show a rise in the catch per effort, in the southern region up to 28 %, in the northern up to 18 %. However, the

fishery in the central North Sea in the spawning time shows a marked reduction of the catch per unit of effort, as did the fishery on the pre-spawning and spent herring in the southern North Sea. The reduction of the catch per unit of effort in the central North Sea was more serious, however, than in the southern North Sea (18 % against 7 %).

Thus we see that the summer fisheries show an improvement of the catch per unit of effort, while at the same time the fisheries on spawning or pre-spawning concentrations of herring show a reduction. Although for the Dutch fisheries exact data are missing, we have reasons to believe that the summer drift-net fisheries are mainly concerned with rather young herring. In the fisheries for spawning herring and herring on the way towards or from the spawning grounds both young and old herring are caught. If this is true, the data shown above would indicate that the abundance of young herring measured by weight, has increased in recent years and the abundance of older herring has decreased at the same time. This increase of young herring might be due to a faster growth-rate combined with recruitment at an earlier age.

This would fit in with the fact that the October catches of the East Anglian fisheries increased slightly and the November catches decreased, as November, rather than October, tends to be the season of the older herring (Hodgson, 1933).

There is, however, one exception to the rule, that the fisheries for spawning herring show a reduction in the catch per unit of effort since the war. This concerns the fishery for spawning herring along the Scottish coast in August-September. Although the Dutch drift-net fishery in this region is not a very important one, the rather sparse data show a definite improvement of the catch. Comparing again the two periods 1947—1950 and 1951—1955 the mean catches per unit of effort in the area in August and September were 24 and 44 kantjes. This might indicate that, contrary to the spawning populations in the southern and central North Sea, the spawning stock along the Scottish coast has increased by weight.

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2.

Recent Changes in the North Sea Herring Fisheries

By B. B. Parrish and R. E. Craig
Marine Laboratory, Aberdeen.

In the working paper circulated to members of the Herring Committee, Cushing and Burd drew attention to some important changes in recent years in the yields from and the composition of the catches of the East Anglian herring fishery. They ascribed these events partly to changes in the biology, and partly to an increase in fishing mortality of the "Downs" stock of herring. These events together pose a Southern Bight problem, which it was the task of this Committee to examine in the light of collective statistical and biological data.

Of importance to this enquiry are the results of herring investigations in other parts of the North Sea, many of which are published in recent volumes of *Annales Biologiques*, which show clearly that striking changes have also taken place in other North Sea herring fisheries. Amongst these are the Scottish drift-net fisheries in the northern North Sea, in which changes in both productivity and catch composition have taken place since the second world war. It is felt therefore than an analysis of the changes in these fisheries and a comparison of their nature with those at East Anglia may be of direct relevance—not only to the Southern Bight problem, but also to a better understanding of the North Sea herring fisheries as a whole.

The Scottish North Sea Drift-Net Herring Fisheries

The Scottish drift-net fisheries, which are conducted between April and September over a wide area in the northern North Sea, can be divided into three main components. They are:—

(i) The "Shetland" fishery, which is conducted between May and August mostly on grounds within 60 miles of the port of Lerwick, to the east and south of the Shetlands.

(ii) The "Buchan" fishery which extends from late April or early May to early September on grounds off the Scottish east coast and the Moray Firth, mostly within a range of 70 miles from the major fishing ports Fraserburgh and Peterhead.

(iii) The much smaller and more recent north-eastern North Sea "boxing" fishery, which is conducted on grounds mostly to the east of longitude 1° E. and north of latitude 58° N. in April and May. The vessels fishing in this area subsequently join in the "Buchan" fishery in the period June to early September.

The general biology of the herring stocks in the Scottish area was elucidated during the inter-war period, notably by Wood (1936, 1937, 1946), and is described in much greater detail in the appropriate publications. The disposition of these fisheries is shown in Figure 1, and the main features of the herring stocks on which they are based may be briefly summarized as follows:—

1. The stock fished between April and September in the Scottish fisheries is composed of two distinct biological groups of herring; a main group, which we will term "summer-autumn" spawners[1]) which spawns between August and January or February on grounds ranging from the Scottish east coast to the Eastern English Channel, and a smaller, "winter-spring" spawning group, which is confined principally to the eastern and northern parts of the Scottish area, and which is represented chiefly by fish between 2 to 5 years of age. Most of the members of this group are adolescents of the major "Atlanto-Scandian" group of herring which spawn off the west coast of Norway and along the edge of the continental shelf and to the north and west of Scotland.
2. The "summer-autumn" group can, for the present purpose, be divided into two components; an "adult" component comprising all age-groups which have been part of the open-sea stock for

[1]) This group comprises the main body of herring in the North Sea spawning between the Scottish east coast in the north and the Eastern Channel grounds in the south. It thus includes the groups known widely as the "Banks" and "Downs" stocks. In view of the uncertainty about the "racial" distribution of these groups, no attempt is made here to distinguish between them.

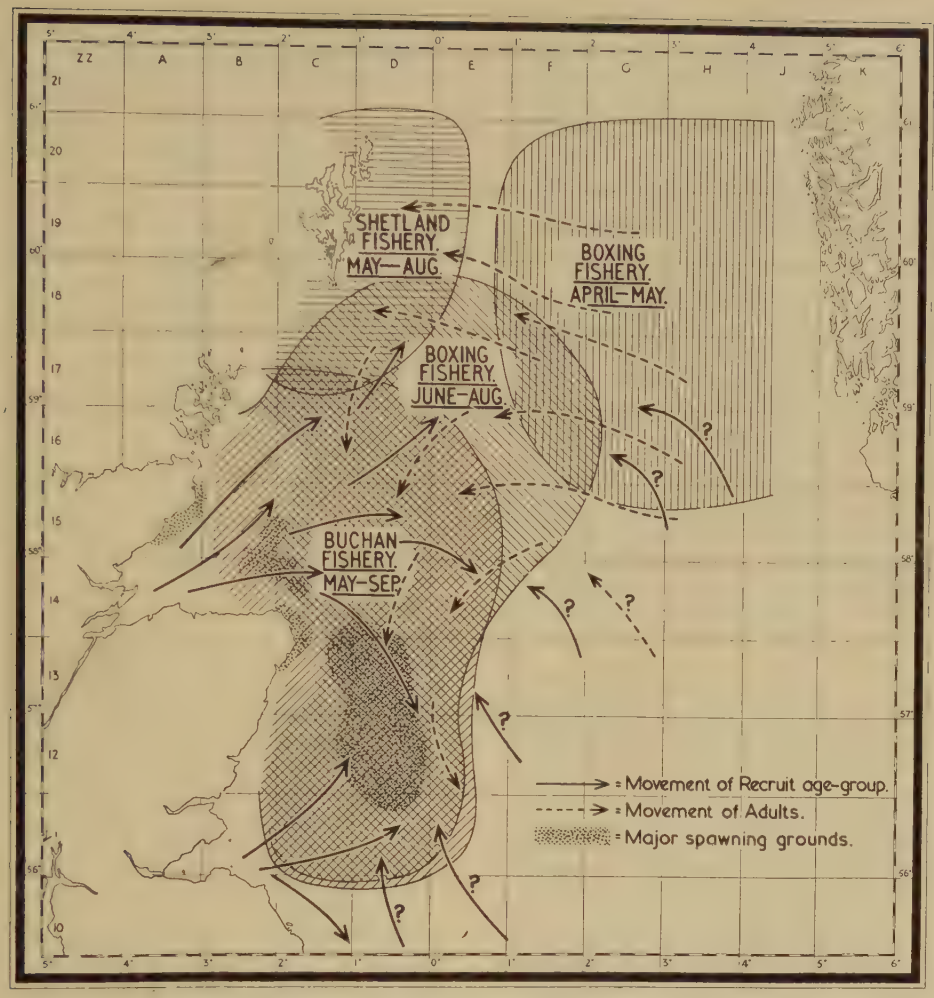

Figure 1. General scheme of fishing operations and of movements of autumn-spawning herring in the northern North Sea between April and September.

one or more years, and most of which have spawned at least once, and an "adolescent" component consisting principally of 3-year-olds (2 winter-rings on the scales) which have migrated in the spring and early summer from the nursery areas on to the main open-sea fishing grounds.

The main concentrations of the "adolescent" component first appear in the western parts of the "Buchan" fishing grounds in April. These subsequently spread over these grounds and in June and July constitute part of the stock exploited by the "Buchan" fishery. The centres of distribution do not extend to the Shetland fishing grounds during this period nor generally to the more easterly areas exploited by the "boxing" fishery. In late July and early August, there is a general movement of these young herring southwards, and only a small part of the original concentrations remain on the "Buchan" grounds and join the members of the "adult" component on the spawning grounds off the Scottish east coast.

Major concentrations of the "adult" component are found in the north-eastern regions of the North Sea in March, April and early May, where they are exploited by the "boxing" fishery. This body of fish then gradually spreads westwards during late May and early June and invades the "Shetland" and "Buchan" fishing areas. They remain on these grounds during the pre-spawning months and extend their range southwards. After spawning members of both components appear to spread eastwards and northwards into deeper water, where they are fished by trawlers in several parts of the North Sea. However, their subsequent movements prior to their reappearance in the north-eastern North Sea in the following spring are not clearly known.

Thus, the herring concentrations fished by the three Scottish fisheries differ in two important re-

spects. The "boxing" and "Shetland" fisheries are centred chiefly on the "adult" component of the "summer-autumn" group and smaller concentrations of the younger members of the "winter-spring" group. On the other hand the "Buchan" fishery in the pre-spawning months May-July is centred almost exclusively on feeding concentrations of the "adolescent" and "adult" components of the "summer-autumn" group, and in August and September on spawning fish of each component.

3. Not all of the members of the "summer-autumn" group of herring fished in the northern North Sea in summer spawn on the Scottish spawning grounds. Results of tagging experiments (Wood, Parrish, and McPherson, 1955) have confirmed the results of earlier investigations (Wood, 1946), indicating a movement of fish from the north-western North Sea feeding grounds to spawning grounds in the central and southern regions of the North Sea. Thus, the stock exploited in the Scottish fisheries during the summer constitutes a pre-spawning reservoir from which many, if not all, of the concentrations of "adult" spawners on central and southern North Sea spawning grounds are derived.
4. The localities in which the main concentrations of both the "adolescent" and "adult" components of the northern North Sea stocks are found change from year to year, due undoubtedly to changes in migrations in response to fluctuations in environmental factors. This often has an important bearing on the success of the Buchan and Shetland drift-net fisheries, which are centred on traditional grounds within daily landing distance from the major fishing ports. Thus, the extent to which the "adult" component penetrates westwards in spring will determine the success with which the Shetland and Buchan drifter fleets contact these shoals, or a shift in the concentrations of the "adults" northwards or southwards in the north-western North Sea will govern the relative concentrations on the Shetland and Buchan grounds. Similarly, the movements of the "adolescent" component will determine the extent of their penetration on to the Buchan grounds and beyond.

Changes in the Buchan and Shetland Drift-Net Fisheries

Statistics of annual catch are available for the Buchan and Shetland fisheries from the beginning of the present century. Crude measures of total effort are available for the Buchan fishery since 1906, and for the Shetland fishery since 1923. These data are given in Table 1.

While these statistics, particularly those of effort, are subject to limitations as measures of the quantities of herring caught and the effort expended, they do nevertheless reflect the main fluctuations and trends

Table 1. Catch and effort statistics for Buchan and Shetland drift-net fisheries[1]) 1900—1955

Year	Total catch (1000's of crans)		Total effort (1000's of landings)		Catch per landing (crans)	
	Buchan	Shetland	Buchan	Shetland	Buchan	Shetland
1900	132·4	321·2	—	—	—	—
1	344·2	430·1	—	—	—	—
2	527·2	294·7	—	—	—	—
3	449·7	299·3	—	—	—	—
4	558·9	543·3	—	—	—	—
5	452·6	645·8	—	—	—	—
6	496·0	458·9	28·4	—	17·5	—
7	730·3	468·4	29·2	—	25·0	—
8	611·3	516·8	38·3	—	16·0	—
9	490·4	362·9	33·3	—	14·7	—
1910	678·1	468·9	37·4	—	18·1	—
11	539·9	392·2	39·3	—	13·7	—
12	554·3	398·2	38·5	—	14·4	—
13	529·4	202·7	39·9	—	13·3	—
14	493·3	273·5	31·8	—	15·5	—
15	10·4	26·3	1·5	—	6·9	—
16	185·9	134·5	12·9	—	14·4	—
17	170·3	34·4	15·8	—	10·8	—
18	186·5	27·9	17·3	—	10·8	—
19	496·8	145·1	26·1	—	19·0	—
1920	401·6	88·8	31·7	—	12·4	—
21	259·7	168·7	19·2	—	13·5	—
22	243·4	256·4	18·7	—	13·0	—
23	372·5	254·5	20·7	14·3	18·0	17·8
24	500·6	341·7	28·5	15·2	17·6	22·5
25	248·1	191·6	20·6	14·6	12·0	13·1
26	391·9	226·5	26·3	14·6	14·9	15·5
27	396·0	180·2	29·1	13·4	13·6	13·4
28	389·9	240·3	30·6	12·4	12·7	19·5
29	442·2	304·2	29·1	14·3	15·2	21·2
1930	349·2	232·1	31·7	12·0	11·0	10·7
31	177·9	108·9	21·1	9·6	8·4	11·4
32	221·6	132·0	22·3	8·7	9·9	16·7
33	210·3	67·3	25·9	6·4	8·1	10·5
34	238·5	153·5	21·6	8·4	11·0	18·4
35	297·8	204·0	24·5	10·1	12·1	20·3
36	253·1	171·5	26·4	11·5	9·6	14·9
37	189·5	144·2	20·3	8·9	9·3	16·2
38	242·7	171·4	17·9	8·7	13·6	19·9
39	190·6	56·2	22·9	6·7	8·3	8·4
1940	17·1	0·3	4·6	0·2	3·7	1·5
41	20·1	5·1	1·3	0·6	15·5	8·5
42	57·4	6·8	2·8	0·9	20·5	7·7
43	94·5	10·1	5·9	0·7	16·0	15·1
44	195·6	9·9	9·8	0·8	20·0	12·4
45	259·2	12·2	11·0	0·9	22·6	12·9
1946	365·0	63·0	17·1	1·8	21·3	34·8
47	292·6	119·6	22·1	3·4	13·3	32·2
48	284·5	143·5	19·9	5·2	14·3	27·9
49	137·9	74·3	13·2	4·6	10·4	16·2
1950	106·2	53·1	7·6	3·4	13·9	15·6
51	159·8	31·5	11·9	1·9	13·4	16·6
52	300·6	49·2	12·7	2·4	23·7	20·5
53	343·4	15·7	15·1	1·3	22·7	12·1
54	239·9	23·4	10·4	1·7	23·1	13·8
1955	263·5	43·2	8·8	1·7	29·9	25·4

[1]) The statistics for the Buchan fishery are the combined totals for the three ports Fraserburgh, Peterhead and Wick, and for the Shetland fishery, the landings at Lerwick.

in these fisheries; also the estimated catches per unit effort give a general indication of the more important changes in the abundance of herring available to capture on the grounds.

A number of important features of these fisheries, of particular relevance to the present enquiry, emerge from these data. They show:—

1. Fairly large short-term fluctuations in the catches of herring on both the Buchan and Shetland grounds during the inter-war period.
2. A large increase in average catch on the Shetland grounds immediately after the second world war, followed by a steady decline up to 1951 and thereafter marked short-term fluctuations.
3. No significant increase in average catch on the Buchan grounds immediately after the first world war, and only a relatively small increase during and after the second world war.
4. A marked increase in average catch on the Buchan grounds after 1951, to give in 1955 the highest average catch since these records were begun in 1906.

These features reveal some similarities and some striking contrasts with the changes in the East Anglian fishery, as described in Part III of Cushing and Burd's paper. The statistics for the Shetland fishery show the same marked increase in abundance of herring immediately after the second world war as in the East Anglian fishery. On the other hand the post-war increases are much less marked in the statistics of the Buchan fishery and, in the years following the first world war, the catch per unit effort was no greater than in the years before 1914.

In most striking contrast to the East Anglian fishery is the increase in the catch per unit of effort in the Buchan fishery in the years after 1951. Whereas at East Anglia there was a general decline in the catch per unit of effort after 1950, in the Buchan fishery it increased sharply in 1952 and has remained at a relatively high level since then. A trend in catch per unit effort, somewhat similar to that at East Anglia, is however shown by the post-war Shetland statistics up to 1951; these show a steady decline in catch per unit effort from a high immediate post-war value. It is striking however that the catches at Shetland did not increase over the pre-war level during the war years, so that it is difficult to attribute the subsequent increase to the effect of a reduced fishing mortality and an accumulation of older fish. The inference is similar from catch per unit of effort and average age data for the German trawl fisheries for herring on the Fladen, Gut and Dogger grounds (Krefft, Schubert, and Sahrhage, 1955). Only in the Fladen fishery do these data show a post-war increase in catch per unit effort over the late pre-war years. Furthermore, the Fladen and Dogger data show no significant increase in the average age of the catch, and the catch per unit effort values were higher in each of these fisheries in 1946 and 1947 than in 1945 when fishing commenced after the wartime respite.

It is not possible, therefore, from the raw statistics of the Scottish and other northern and central North Sea fisheries to detect any significant effect of reduced wartime fishing intensity, nor do they provide clues to changes in the composition of the catches during the post-war period. These can, however, be gauged from abundance indices of the age-groups making up the commercial catch. No completely satisfactory indices of abundance are available (see Part III, Cushing & Burd, 1956) but rough assessment can be made from the catch per landing data and the age compositions determined from sampling surveys of the commercial catch each year.

Indices of abundance for the Buchan and Shetland fisheries have been determined from these data for the period 1930—1955. For the Shetland data, presented in Table 2, average indices for the whole season's fishing are given, but for the Buchan fishery, indices have been calculated separately for the pre-spawning period, May to July (Table 3), and for the spawning period August and September (Table 4). This division is made because, as explained earlier, of the general change in the composition of the stock in this area at the onset of the spawning season.

Shetland fishery

Representative age and length sampling of the Shetland fishery did not commence after the second world war until 1948, so that there are no data for the period immediately after the war-time respite from fishing, but a number of important features are revealed.

(i) The average abundance of the younger age-groups[1]) (3- to 5-year-olds), which are a mixed stock of North Sea "summer-autumn" herring and of "winter-spring" spawners, has not changed significantly between the pre-war and post-war periods. In both periods, except in 1955, recruitment to the fishery at three years of age was very small, and it was spread principally over age-groups IV and V.

(ii) The average abundance of fish older than five years of age has been higher in the post-war years than during the period 1930—1939. The average abundance indices for each of the age-groups older than five years in the two periods are as follows:—

		Crans per landing	
Age	Winter-rings	1930—1939	1948—1955
6	5	3·1	2·6
7	6	1·8	2·2
8	7	1·2	2·1
9	8	0·9	1·6
older than 9	> 8	0·4	2·9

[1]) The ages given in this paper refer to the number of summer growth-zones on the scales and otoliths and are always one more than the number of winter-rings. This brings the age reference in conformity with that used in the paper by Cushing and Burd.

Table 2. Abundance indices (crans per landing) of age-groups in Shetland fishery in the period May—August 1930—1955 (exclusive of 1940—1947)

Age	3	4	5	6	7	8	9	Older than9
Winter-rings	2	3	4	5	6	7	8	>8
Year								
1930.....	3·3	3·3	3·9	4·6	0·9	1·4	0·9	0·2
1931.....	0·6	4·6	1·0	1·1	1·3	1·0	0·9	0·4
1932.....	0·1	5·2	3·7	1·3	1·1	1·2	1·2	1·0
1933.....	0·2	0·9	4·2	1·3	0·6	0·3	0·4	0·5
1934.....	0·1	5·4	2·6	5·6	1·5	0·5	0·3	0·3
1935.....	1·2	3·5	3·6	3·4	5·2	1·0	0·5	0·4
1936.....	0·03	2·4	3·7	2·0	1·7	3·3	0·6	0·5
1937.....	0·0	1·6	4·6	4·9	1·8	0·8	3·0	0·5
1938.....	0·04	1·3	2·2	6·1	2·9	1·9	1·1	3·5
1939.....	0·1	0·5	2·6	1·1	1·5	0·7	0·3	0·4
1948.....	0·1	4·5	2·9	6·0	4·8	4·2	2·8	2·0
1949.....	1·2	0·7	3·3	1·5	2·6	3·1	1·6	2·0
1950.....	0·1	2·5	2·5	3·4	2·3	2·4	1·6	1·0
1951.....	0·2	1·2	3·7	1·8	2·8	1·8	2·1	3·1
1952.....	0·6	2·2	1·5	2·6	1·5	2·5	1·9	6·1
1953.....	0·8	2·4	1·5	1·2	1·6	0·9	0·9	2·1
1954.....	0·4	2·1	2·3	1·4	1·0	1·3	0·9	4·6
1955.....	4·8	7·1	4·0	3·0	1·1	0·9	1·0	2·2

(iii) However, there has been a marked decline in the catches of these older age-groups during the post-war period, and in the years 1953—1955, their abundance was smaller than the pre-war average. This decline took place quite suddenly in 1953, as is shown by the following indices of abundance for these age-groups in each of the years 1948—1955:—

1948	13·8	1952	12·0
1949	9.3	1953	5·5
1950	7·3	1954	7·8
1951	9·8	1955	5·2

Table 2 shows that this decrease cannot be attributed to lower brood strength for these years; nor can it be associated with a marked reduction in the stock of "winter-spring" spawning herring on the Shetland grounds. It must be attributed in the main to a sudden fall off in the catchable stock of the adult component of the "summer-autumn" spawning group.

Buchan pre-spawning fishery

Again, age sampling of the catches did not commence immediately after the second world war, but the following important features are revealed:—

(i) Since 1951 there has been a striking increase in the abundance of 3-year-olds in the catches. Whereas in post-war years up to 1951 recruitment by this age-group was at about the same average level as in pre-war years, in 1952 it increased approximately fourfold over this average level, and has attained even higher levels since then.

Table 3. Abundance indices (crans per landing) of age-groups in Buchan fishery in pre-spawning period, May—July, 1930—1955, (exclusive of 1940—1946)

Age ..	2	3	4	5	6	7	8	9	Older than9
Winter-rings..	1	2	3	4	5	6	7	8	>8
Year									
1930..	0·1	3·3	4·8	1·7	2·5	0·7	0·6	0·3	—
1931..	—	1·0	4·5	2·1	1·1	1·1	0·8	0·6	0·3
1932..	0·03	1·3	7·4	2·1	0·6	0·2	0·2	0·1	0·1
1933..	—	1·4	3·6	1·5	0·5	0·1	0·1	—	—
1934..	—	1·7	2·9	4·2	1·3	0·5	0·2	0·1	0·1
1935..	—	2·7	7·1	1·3	1·7	0·5	0·2	0·1	—
1936..	0·03	0·8	3·9	2·3	0·5	0·8	0·8	0·1	0·1
1937..	—	1·8	2·3	3·7	1·6	0·2	0·3	0·2	0·1
1938..	0·1	1·1	8·4	2·0	2·4	0·7	0·2	0·2	0·1
1939..	—	3·2	3·0	3·0	0·4	0·3	0·1	—	—
1947..	—	4·2	3·0	2·9	1·7	1·0	0·4	0·1	0·2
1948..	0·1	2·0	3·6	1·5	2·3	1·3	0·8	0·4	0·4
1949..	0·04	3·0	2·1	1·1	0·6	0·7	0·5	0·3	0·2
1950..	0·02	1·7	5·7	2·5	1·4	0·9	0·9	0·6	0·4
1951..	0·03	1·4	3·1	4·3	1·8	1·0	0·7	0·6	0·6
1952..	—	8·4	4·6	4·4	4·2	1·9	1·1	0·7	1·1
1953..	0·03	8·8	6·5	2·2	1·7	1·6	0·8	0·4	0·5
1954..	0·1	13·8	4·2	1·8	0·8	0·7	0·5	0·2	0·3
1955..	0·01	22·5	5·1	1·1	0·6	0·3	0·3	0·1	0·2

(ii) During the period of increasing abundance of 3-year-olds, the abundance of 4-year-olds has remained at about the same or at a slightly higher level than previously.

Thus, as in the East Anglian fishery, there has been a major change in the relative proportions of 3- and 4-year-olds in the Buchan pre-spawning catches. This important change is similar and it took place in the same year, as in the East Anglian fishery. Only in 1955 do the two fisheries differ markedly in this feature. In the Buchan fishery the abundance of 3-year-olds reached its highest value in 1955 but it dropped sharply from the 1953—54 level in the East Anglian fishery. In the Buchan fishery the abundance of 4-year-olds increased slightly following the increase in recruitment of 3-year-olds, but in the East Anglian fishery, the abundance of 4-year-olds decreased.

(iii) As in the Shetland fishery, the average post-war abundance of the older age-groups has been greater than in the pre-war period. The averages for each of the age-groups above 5 are as follows:—

		Crans per landing	
Age	Winter-rings	1930—1939	1947—1955
6	5	1·3	1·7
7	6	0·5	1·0
8	7	0·4	0·7
9	8	0·2	0·4
older than 9	>8	0·1	0·4

Again this increase cannot be attributed to greater brood strength in post-war years. It is evident also from Table 3 that these high values cannot be as-

signed to high indices of older fish in the early post-war years since the total abundance of these age-groups was higher in the years 1951—1953 than in the years 1947—1950. In 1954 and 1955, however, the total abundance of these age-groups fell again, to reach in 1955 its lowest post-war value.

It is interesting to note that the year of high total abundance of these older age-groups in the Shetland catches, 1952, was also the year of their highest post-war abundance in the Buchan pre-spawning fishery, and in both fisheries there was the same sharp fall off in abundance in 1953 and subsequent years.

Buchan spawning fishery

The data for this fishery reveal some similar and some contrasting features with the pre-spawning fishery, of which it is a continuation. Most relevant of these are:—

(i) The abundance of 3-year-olds in the post-war years up to 1951 was at the same general level as in pre-war years. After 1951, as in the pre-spawning fishery, it increased and remained at a relatively high level in the succeeding years, but still at a much lower level than in the pre-spawning fishery.

(ii) Unlike the pre-spawning fishery, there was a marked increase in the abundance of 4-year-olds following the increase in recruitment of 3's, which is also reflected in the subsequent catches of 5's and 6's.

(iii) As in the Shetland and the Buchan pre-spawning fisheries, the average abundance of fish older than 5 years of age was greater in the post-war than in the pre-war periods. This is shown by the following average abundance indices for each age-group in the two periods.

		Crans per landing	
Age	Winter-rings	1930—1939	1948—1955
6	5	0·9	2·1
7	6	1·0	3·7
8	7	0·7	1·5
9	8	0·5	1·4
older than 9	> 8	0·4	2·4

Again this cannot be explained as a direct consequence of an increase in brood strength in the post-war years, nor to the weighting given by high abundance of older fish in the immediate post-war years. No substantial decline in the abundance of these older age-groups can be detected during the post-war period; in fact there has been a marked increase in the abundance of the oldest broods.

There are therefore some striking similarities between the post-war changes in the composition of the catches in the Scottish and East Anglian drift-net fisheries and some differences. Thus, the Buchan pre-spawning and the Shetland fisheries together show a similar marked increase since 1951 in the catches of 3-year-olds and an accompanying change in the ratio of 3- and 4-year-olds, and also a reduction since 1952 in the catches of the older age-groups. Only in the Buchan spawning fishery are the changes not paralleled; here there has been no marked decline in the catches of the older age-groups, but instead a general increase.

Interpretation of Changes in Scottish and East Anglian Catches since 1950

It is evident from the above that several of the phenomena detailed in CUSHING and BURD's paper are not confined to the Southern Bight fisheries, but are common to drift-net fisheries in widely separated regions of the North Sea.

The two important widespread changes which require examination are:—

(i) The increase in the catches of 3-year-olds since 1951 and the associated change in the relative proportions of 3- and 4-year-olds.

(ii) The reduction in the catches of older age-groups in some fisheries since 1952.

Increase in catches of 3-year-olds

There are two possible alternative explanations for this change:—

(i) An increase in brood strength, giving a greater total abundance of herring of this age-group on the fishing grounds.

(ii) An increase in the "availability" of each year-class to capture at this age.

Data at our disposal indicate that the observed change in the north is probably the result of the combined effect of both of these factors. Evidence that there probably has been some increase in brood strength is given by:—

1. The increase in the catches of 4-year-old and older fish in the Buchan pre-spawning and spawning fisheries (Tables 3 and 4) the Aberdeen offshore "boxing" fishery, and to a lesser extent the Shetland fishery (Table 2).
2. The recent increase in the abundance (as measured by drift-net landings) of herring on the Moray Firth nursery grounds. This is shown by the following data for the Scottish "halflin" fishery carried out in the upper reaches of the Moray Firth between October and March.

Year	Total catch (crans)	Av. catch per landing (crans)
1945—46	3,215	4·2
1946—47	7,958	9·9
1947—48	356	4·5
1948—49	3,409	9·9
1949—50	3,790	13·4
1950—51	2,790	7·6
1951—52	19,066	24·4
1952—53	38,885	23·8
1953—54	61,773	23·3
1954—55	25,263	14·7
1955—56	34,644	22·0

The catches in this fishery are composed almost entirely of the single age-group which appears as 3-year-olds (2 winter-rings) in the open-sea fisheries in the following summer. The marked increase in the catches in this fishery coincided with the jump in the catches of 3-year-olds in the Buchan pre-spawning fishery in 1952 (Table 3). While a part of this increase may well be the result of a change in the "availability" of the halflin stock, it should be noted that there is no evidence that this is so, and it is considered that this increase in catch reflects an increase in brood strength of the respective year-classes. However, while the members of this local nursery stock undoubtedly contribute appreciably to the total stock of 3-year-old recruits to the Buchan fishery, they do not constitute the whole of it; a substantial part of the recruits to this fishery undoubtedly come from other nursery grounds. Therefore, the above figures cannot be taken as measures of the increase in abundance of the total recruit year-classes entering the Buchan fishery after 1951.

That the increase in the catches of 3-year-olds cannot be attributed entirely to increased brood strength is indicated by the general failure of the catches of the 4-year-olds and subsequent age-groups to increase to the extent which would be expected from an increase in brood survival alone. There is, therefore, an indication of a similar change in the recruitment pattern in the Scottish fishery as proposed by Cushing and Burd for the East Anglian fishery. Whereas in both fisheries prior to 1952 a substantial component of each year-class was not recruited to the fishery until 4 years of age, after this time a greater part of the total recruitment took place at 3 years of age.

Such a change could be brought about in one or other of two ways.

(i) A general change in the distribution, behaviour and/or catchability (which we will collectively term "availability") of the 3-year-old fish, resulting in their being present in greater abundance and/or their being more vulnerable to capture over the traditional fishing grounds.

(ii) A change in the policy and method of fishing, resulting in a greater concentration of fishing effort on the grounds inhabited by the smaller, younger fish.

While there have in recent years been changes in the general distribution of fishing effort by the Buchan drifter fleet (Glover, 1955), and the shift has been towards the younger herring areas, it has not been of sufficient magnitude to account for this major change in catch composition; it is probably due more to biological changes affecting the availability of 3-year-olds to the commercial fleets.

As in the Southern Bight, there has been an increase in recent years in length of the constituent age-groups in the Buchan stock. This is shown by the average lengths presented in Table 5, of age-groups III to VI in the Fraserburgh and Peterhead catches in the pre-war years 1935 to 1938 and in the post-war period 1947 to 1955. It is considered that this increase in length has resulted in a greater proportion of the total stock of 3-year-olds becoming available to capture by the commercial fishery than hitherto. This is probably due, partly to a greater proportion of the age-group being retained by the meshes of the drift-nets, and partly to an increase in the proportion of the total stock of 3-year-olds being recruited to the fishing area.

From the data available, therefore, the increase in the catches of 3-year-olds in the Scottish fishery can be attributed at least in part to the same general causes as in the Southern Bight fisheries. In the light of these and other published data (Ancellin, 1953—54; Gilis, 1950—1955; Krefft, Schubert, and Sahrhage, 1955; and Andersson, 1954), the growth increase, probably together with an associated change in the incidence of first maturity, can be traced in the catches from all of the major North Sea herring fisheries. It appears therefore to be a general biological feature of the whole North Sea stock of "summer-autumn" herring, and has resulted in a change in the whole recruitment pattern to the respective fisheries. A direct consequence of such a change in the pattern of recruitment to the fisheries would be an increase in fishing mortality amongst the 3-year-olds, which for any given brood strength will result in some decrease in the abundance of 4-year-olds and older fish and will explain in part at least the fall off in abundance between the 3- and 4-year-olds in the drifter catches.

Table 4. Abundance indices (crans per landing) of age-groups in Buchan fishery in spawning period, August—September, 1930—1955 (exclusive of 1940—1946 and 1948).

Age ..	2	3	4	5	6	7	8	9	Older than 9
Winter-rings..	1	2	3	4	5	6	7	8	>8
Year									
1930..	—	0·6	1·6	1·2	0·8	0·7	0·8	0·4	0·3
1931..	—	1·0	1·3	0·8	0·7	0·5	0·5	0·4	0·3
1932..	—	0·03	0·6	3·3	0·8	0·4	0·2	0·1	0·2
1933..	—	1·1	2·4	4·5	0·7	0·8	0·6	0·3	0·5
1934..	—	0·3	1·0	2·0	6·3	1·2	1·0	0·6	0·5
1935..	—	0·9	3·8	1·2	1·8	3·2	0·4	0·5	0·5
1936..	—	0·1	1·4	1·8	0·9	1·6	2·2	0·7	0·6
1937..	—	0·2	0·3	1·8	1·4	0·2	0·4	1·2	0·3
1938..	—	1·7	3·2	0·8	1·0	0·7	0·3	0·2	0·6
1939..	—	1·4	1·1	0·8	0·2	0·3	0·2	0·1	0·2
1947..	—	0·4	0·9	1·9	2·8	1·1	1·8	1·1	1·2
1949..	—	0·3	0·9	3·3	2·3	3·3	2·6	1·2	1·4
1950..	—	1·4	1·0	1·0	1·2	1·1	1·5	2·9	1·4
1951..	0·2	1·2	2·8	2·0	0·8	1·6	1·4	1·9	2·1
1952..	—	2·7	1·4	2·5	1·4	0·5	1·0	0·9	3·4
1953..	0·1	5·7	6·6	1·7	2·9	1·6	0·6	1·3	3·9
1954..	—	4·4	4·1	5·2	1·3	2·2	1·2	0·6	3·5
1955..	—	9·6	5·3	3·6	4·0	1·2	1·5	1·0	2·6

No sampling took place in 1948

Table 5. Average lengths (cm.) of 3-6-year-old herring in Buchan fishery in May—September, 1935—39; and 1947—1955

Age	3	4	5	6
Winter-rings	2	3	4	5
Year				
1935	24·0	24·3	25·8	25·9
1936	24·2	25·0	26·2	27·4
1937	24·2	25·0	26·4	27·3
1938	23·6	24·9	26·1	27·1
1939	23·9	24·7	25·9	27·2
1947	24·7	25·4	26·5	27·7
1948 omitted due to incomplete sampling.				
1949	23·3	24·9	26·5	27·1
1950	24·5	24·9	26·1	27·7
1951	24·7	**25·8**	25·9	26·5
1952	24·9	26·3	**26·8**	27·3
1953	24·5	26·4	27·0	**28·1**
1954	24·7	26·9	28·1	28·7
1955	24·2	26·8	28·7	29·3

Table 6. Estimated annual percentage mortality rates for the Buchan pre-spawning fishery, 1930—1955

Years/Age-groups	III-IV	IV-V	V-VI	VI-VII	VII-VIII	VIII-IX
1930–31	*	56·1	35·3	56·0	*	0·0
1931–32	*	53·1	71·2	81·9	81·9	87·3
1932–33	*	79·8	76·1	83·1	50·0	100·0
1933–34	*	*	13·3	0·0	*	0·0
1934–35	*	55·0	59·2	61·4	60·0	50·0
1935–36	*	67·6	61·4	53·0	*	50·0
1936–37	*	5·1	30·4	60·0	62·3	75·0
1937–38	*	13·0	35·1	56·1	0·0	33·3
1938–39	*	64·1	80·0	87·4	85·9	100·0
1947–48	14·3	50·0	20·6	23·5	20·0	0·0
1948–49	*	69·4	60·0	69·5	61·5	62·5
1949–50	*	*	*	*	*	*
1950–51	*	24·5	28·0	28·6	22·2	33·3
1951–52	*	*	2·3	*	*	0·0
1952–53	22·6	52·0	61·2	62·0	58·0	63·7
1953–54	52·1	72·2	63·7	58·9	68·7	75·0
1954–55	63·0	73·9	66·7	62·6	57·0	80·0

* Second year frequencies greater than first year frequencies.

Changes in abundance of the older age-groups

It has been shown already that, as in the East Anglian fishery, the catches of fish older than 5 years have undergone marked changes in the Scottish fisheries since the war. Most striking of these has been a general increase since the war, followed in 1953 by a sharp decline, in both the Buchan pre-spawning and the Shetland fisheries. Can this be attributed to an increase in the fishing mortality rate as proposed for the East Anglian fishery by Cushing and Burd?

In Table 6 are given the apparent total mortality rates estimated from the data in Table 3 for each year-class in successive years of life in the Buchan pre-spawning fishery between 1930 and 1939, and between 1947 and 1955.

The most striking feature shown by these data is the large variation from year to year in the values of the mortality rates for the different age-groups. Thus, in the pre-war period, mortality rates were high for all year-classes between 1931 and 1933, between 1934 and 1936, and between 1938 and 1939; between 1936 and 1938 they were intermediate, and between 1933 and 1934 they were very small or were negative in value. Similar changes are evident in the post-war period; high mortality rates characterize the years 1948—1949 and 1952—1955; intermediate values the years 1947—48 and 1950—51, and very small or negative values the years 1949—50 and 1951—52.

The data strongly indicate wide fluctuations in "availability" of these age-groups in the fishery. Thus, in the post-war period it appears that the years 1950—52 were years of high "availability" in the Buchan fishery, relative to the preceding and succeeding years; and, similarly, 1934 was a year of high "availability" in the pre-war period, and 1932, 1933, and 1939 were years of low "availability". "Availability" therefore appears to be an important factor in determining the short-term fluctuations in the catches of the older age-groups in the Buchan fishery and it is important to consider whether the striking decline in the abundance of the older age-groups since 1952, and the increase in the apparent mortality rates, can be largely attributed to this factor. That this is so is suggested by the following:—

(i) The catches by the Aberdeen "boxing" fishery in the north-eastern North Sea in April and May, a major component of which are the older age-groups of the "summer-autumn" group of herring, have not decreased in recent years but have remained at a relatively high level since 1952. The statistics of catch and effort, and a rough measure of catch per unit of effort for this fishery in April and May between 1949 and 1955 are as follow:—

	Total catch (crans)	Number of landings	Av. catch per landing
1949	17,233	230	74·9
1950	17,995	246	73·2
1951	10,754	248	43·4
1952	24,167	324	74·6
1953	30,975	420	73·7
1954	20,812	272	76·5
1955	25,341	338	75·0

(ii) The abundance indices of the older age-groups in the Buchan spawning fishery have not declined during the period of the decline in the pre-spawning fishery. It appears in fact, that there has been an increase in the numbers of the oldest age-groups on these spawning grounds in recent years.

(iii) No measures of effective total effort are available for the major adult herring fisheries in the North Sea over the period, but only in the Channel trawl fishery is there evidence of a marked increase in the total effort after 1950. (Part III of Cushing and Burd's paper). Thus it appears that there has been no increase in fishing effort

in the period 1953—55, sufficient to account for the increase in total mortality rate in the northern North Sea fisheries. However, effort data for the whole North Sea herring fisheries are urgently required.

(iv) The age compositions of the catches in the northern and central North Sea trawl fisheries, which are known to exploit part if not the whole of the same body of herring as the Scottish drifters are not characteristic of a heavily fished stock. This is evident from the data presented in Figure 10, of Part II of CUSHING and BURD's paper. These indicate average mortality rates between successive age-groups over 5 years of age in the period 1952—1954 of not more than 25 % per annum, which were in fact no greater than the mortality rates in the periods 1946—49 and 1950—51. Similar indications are given by the age compositions of Fladen trawl catches landed in Aberdeen (Ann. Biol., **8**—**11**).

This information, which it must be emphasized is not proof, strongly suggests that there has been a major change in the "availability" of the older groups in the Buchan pre-spawning and the Shetland fisheries since 1952 rather than a marked increase in the fishing mortality rate. It is probable that this is mainly the result of a change in herring distribution in the northern North Sea, resulting in the main centres of density of the shoals being nearer to the fringes of the grounds fished by the Buchan and Shetland fleets. (It must be remembered that the area of activity of the drifter fleets is restricted mainly to within 60-70 miles of the ports.)

While we are not able to provide a full explanation of this "availability" change, it is significant that it has coincided with some marked changes in features of the environment in the North Sea and that it may therefore be a response of the herring to environmental factors. The years since 1951 have been characterized by strong oceanic influence in the northern North Sea, along with some striking changes in the composition, abundance, and time of appearance of some plankton organisms (RAE, 1956; GLOVER, 1955 and 1957). A brief account of the physical and planktonological changes are given in the Appendices to this report and will be reported more fully elsewhere. Hydrographic and planktonic changes have in fact been reported by a number of authors for many North Sea regions and some adjacent waters, and associated changes in the distribution and/or biology of some fish species have been recorded. For example, GILIS (1954) and HODGSON (1954) draw attention to unusually large concentrations of pilchards (*Clupea pilchardus*) in the Southern Bight after 1950, which HODGSON associates with changes in the water temperatures in the period October-December. AURICH (1953) also records marked increases in the spawning of pilchard (*C. pilchardus*), anchovy (*Engraulis encrasicholus*), sole (*Solea vulgaris*), horse mackerel (*Caranx trachurus*) and mackerel (*Scomber scombrus*) in the southern North Sea since 1948, which he relates to increased penetration of Atlantic water into the North Sea. The increase in growth of the herring all over the North Sea is also probably a direct consequence of planktonic and perhaps hydrographic changes.

Table 7. Estimated annual percentage mortality rates for the East Anglian fishery, 1935—1955

(estimated, using data from CUSHING and BURD, 1956).

Years/Age-groups	III-IV	IV-V	V-VI	VI-VII	VII-VIII	VIII-IX	IX-X
1935–36..	*	52·2	*	27·9	52·0	29·4	45·4
1936–37..	*	21·1	44·0	55·4	62·1	41·6	75·0
1937–38..	*	31·5	49·2	57·0	*	42·8	42·8
1946–47..	*	27·8	46·6	16·7	59·0	58·9	57·8
1947–48..	*	31·8	12·4	*	37·1	10·4	60·8
1948–49..	*	24·3	36·4	44·6	80·9	77·1	84·3
1949–50..	*	44·9	38·3	39·2	50·0	27·8	50·0
1950–51..	*	26·5	41·0	43·6	38·1	46·1	61·6
1951–52..	2·1	36·8	27·3	40·6	50·0	42·9	62·0
1952–53..	43·2	56·4	65·5	67·1	64·9	55·0	58·2
1953–54..	34·0	32·0	30·4	6·9	36·3	16·6	66·8
1954–55..	67·2	74·9	66·2	68·0	70·1	76·0	80·0

* Second year frequencies greater than first year frequencies.

This association may be of importance not only to the understanding of the northern fisheries but also those of the south, and it may be useful to consider whether the decline in the catches of the older age-groups in the East Anglian fishery can be attributed, at least in part, to similar changes in "availability", in the wide sense used here.

In Table 7 are given the apparent total mortality rates between each successive year of life, calculated from the data in Table 6 of Part III of CUSHING and BURD's paper, for each year since 1935. As in the Scottish data, these show marked fluctuations in the mortality estimates from year to year, which seem very large to be reconciled with changes in the fishing mortality component alone. Thus, in the period since 1951, mortality rates were very high between 1952—53, and 1954—55, but they were relatively very low between 1953—54; in this year they were lower than in any year prior to 1951 except 1947—48; furthermore, in 1951—52, the rates were no greater than the average for the earlier post-war years, despite a major increase in trawl catches in that year. It is evident that the increase in mortality rate between 1950—55 over the earlier pre-war years is weighted heavily by the very high values for the years 1952—53 and 1954—55.

Therefore, during the period since the major increase took place in the Channel trawl fishery, the estimated apparent total mortality rates in the East Anglian stock have fluctuated widely. In two periods, 1952—53 and 1954—55, they have been relatively high, and in two periods, 1951—52 and 1953—54, they have been relatively low. In one of the high mortality years, 1955, the abundance indices of all age-groups were very low compared with previous years, which strongly suggests low "availability" of the whole stock on the traditional fishing grounds.

Conclusions and Summary

The data reviewed here on recent changes in the composition of the catches of many of the North Sea herring fisheries suggest that the phenomena are so widespread as to have been largely due to a change in the biology of the great population of North Sea "summer-autumn" herring in response to changes in their environment.

The authors consider that the main trends in the fisheries can be most simply explained in terms of faster development of the fish of this group. Thus we find all over the North Sea increased size for age, giving rise to earlier capture by drift-net, advancement of the age of first maturity, and of all stages in the migration pattern. These biological changes, with their implication of changed "availability", are the most important ones. It is also possible, indeed likely, that the older fish of this stock tend normally to migrate northwards to the deeper waters of the northern North Sea, and that this tendency like the other aspects of the life history has been increased in recent years.

In addition, there remains an impression that, while brood strengths have been well up to average in the northern areas, they may well have been somewhat below average in the southern regions, and perhaps particularly among those herring contributing to the eastern Channel fisheries. Although Le Gall (1935), for example, regarded these last as a separate race, Cushing and Burd give cogent reasons for regarding them as part of their "Downs" stock. Perhaps tagging experiments will provide a final answer. Meanwhile, it is part of their case that it is fish spawning in this area which have become most scarce in the East Anglian fishery. It is also fish of this group which spawn so late as not to differ greatly in spawning date from typical coastal spring spawners, such as those of the Moray Firth, Firth of Forth, and Firth of Clyde. All of these groups have provided poor fishings in recent years, probably as the result of extensive environmental changes. Herrings spawning so late as January/February, whether they constitute a separate stock or are late spawners of a larger stock with an extended spawning season, may not have been unaffected by such changes.

Finally, whatever may be the cause of the recent changes in the fisheries, whether due to increased fishing or to "natural causes", wholly or in part, there has undoubtedly been cause for concern recently about the results and prospects of the East Anglian fishery. Some other fisheries have produced more than average in recent years, but investigations show that we do not yet have enough understanding of them. Excessive fishing in relation to the available stock might be "round the corner" without our being able to anticipate it. In these circumstances it seems essential to make every effort to improve our national statistics, and our biological and environmental knowledge, and to pool them so as to be able to anticipate the probable effects of any changes, whether natural or man-made.

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APPENDIX I

The Environment: The Evidence of the Plankton

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Fluctuations in herring fisheries have frequently been ascribed to environmental factors and, in particular, to the fluctuating inflow, into the North Sea, of water of oceanic origin. The plankton has often been used to provide biological indications of the presence of oceanic water. A notable example was the collapse of the Plymouth herring fishery, coinciding with environmental changes which were indicated by the replacement of *Sagitta elegans* by *S. setosa* (Russell, 1936 and Kemp, 1938). Storrow (1930—1932) and Storrow and Cowan (1933 and 1939) attempted to relate the biology of the herring and the varying fortunes of the Scottish and English fisheries to changes in the inflow of mixed oceanic and western coastal water which enters the North Sea near the Shetlands. More recently Rae, at the meeting of the British Association in 1949, drew attention to the close parallel between the annual influx, into the North Sea, of planktonic indicators of mixed water and the temporal and spatial distribution of spawning grounds of the herring; this parallel has been illustrated by Glover (1955, Fig. 7). The collapse of the Shetland herring fishery since 1951 has been associated, tentatively, with the simultaneous invasion of oceanic plankton (Glover, 1955 and Fraser, 1956). Finally, Cushing and Burd (1956) have suggested that the increased growth of East Anglian herrings since 1950 has followed an increase in the supply of *Calanus*, a most important food of the herring; the greater abundance of *Calanus* was also probably the result of an increased oceanic contribution to the North Sea (Glover, 1957).

In the preceding pages, Parrish and Craig (p. 20) have referred briefly to the planktonic and hydrographic evidence for environmental change, coincident with recent changes in the character of the Scottish summer herring fishery.

The evidence for parallel changes in the planktonic environment of the herring is presented in some detail in a separate publication (Glover, 1957) but it may be useful to introduce here, a précis of the main conclusions.

The plankton samples were obtained with the small Plankton Indicator (Glover, 1953). Fishermen from Fraserburgh used the Indicator every night during the summer fishing seasons, from 1947 to 1955. The Indicator was towed at a depth of about eight metres and the samples have been used to estimate between- and within-season fluctuations in the abundance and composition of the plankton at this depth on the Buchan fishing grounds. Figure 1 shows the seasonal fluctuations in abundance of three groups of plankton.

The Cladocera were numerous until 1951; in 1952 they suddenly declined in abundance and thereafter their numbers remained at a very low level with signs of a slight recovery in 1955. *Calanus finmarchicus*, stages V and VI, showed a reverse succession; the early years were characterized by moderate numbers but after 1952 there was a considerable increase in abundance, very high numbers indeed being found in 1954. *Clione limacina* was absent from Indicator samples when the survey started in 1947 and 1948; subsequently it increased in abundance to a maximum in 1953, appearing progressively earlier in each season.

These three examples were chosen because they illustrate a trend which affected the whole plankton community; since 1947 there has been a marked decrease of abundance of typical North Sea species and an increase of organisms which characterize the mixed Atlantic coastal and oceanic water which flows into the northern North Sea. This is summarized in Figure 2 which shows the relative seasonal abundance of the different components of the plankton on the Buchan fishing grounds. The "nine-year mean" was calculated for each organism, that is, the mean number of individuals per cubic metre over the whole period 1947—1955. Those years in which this "nine-year mean" was exceeded for at least a third of the fishing season were classed as years when an organism was "abundant"; when the number per cubic metre exceeded twice the nine-year mean for a third of the season, the organism was said to be "most abundant". Alternative standards were tested and the resulting picture was much the same as that shown in Figure 2.

The organisms were arranged in order so that those species which were plentiful in the early years came first in the list and those which were abundant in the later years came last with a more or less orderly sequence in between (Figure 2). The resulting succession begins with ubiquitous or typical North Sea species such as *Pseudocalanus* and *Paracalanus*, Appendicularia, Cladocera, *Temora longicornis*, and *Centropages hamatus*.

The bottom half of the list, species abundant in the later years, contains organisms which are either

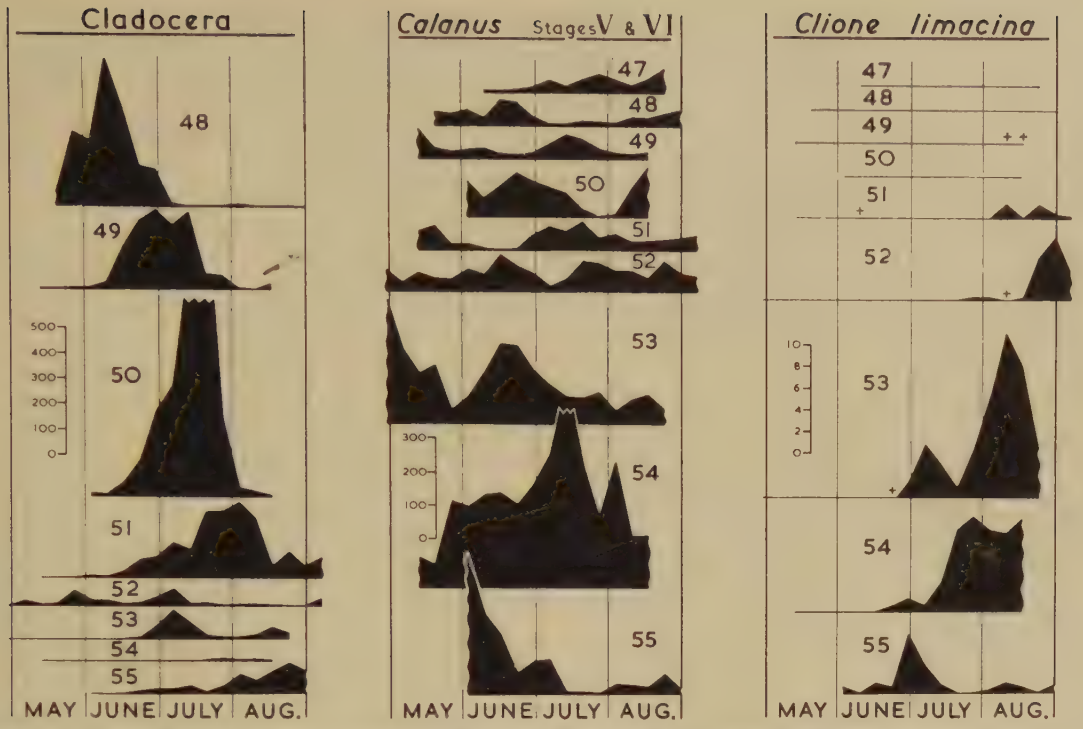

Figure 1. Week-by-week fluctuations in the abundance of Cladocera, *Calanus finmachicus* stages V and VI and *Clione limacina* in samples collected with the Plankton Indicator on the Buchan fishing grounds. The graphs show the mean number of each organism per cubic metre of water sampled. Cladocera were not counted in 1947.

Figure 2. The relative seasonal abundance of the plankton of the Buchan fishing ground. See text for explanation of symbols; a blank space indicates that the organism was not counted in the analysis of the samples in that year (1947 and 1948, only).

accepted as indicators of the mixture of oceanic and coastal water entering the North Sea from the north or which are generally associated with this current, for example, *Tomopteris helgolandica*, *Metridia lucens*, *Candacia armata*, *Limacina* (mostly *retroversa*) euphausiids (mostly *T. inermis*), *Clione limacina*, and *Salpa fusiformis*. Although these organisms, individually, may not always be good indicators of the presence of inflowing water, together they provide strong evidence of its influence. They have been found distributed in a long tongue of plankton extending southwards from the Shetlands and roughly following the pattern of water inflow which Tait (1937, Figure 48) has postulated.

From the plankton, therefore, one might suggest that the period 1947—1955 began with a typically neritic or North Sea type of environment and ended with a strong admixture of elements drawn from the water to the north of the Buchan fishing grounds. The increasing inflow of mixed water appeared to be most marked between 1951 and 1952, probably reached its maximum in 1953 and was maintained in 1954; but there may have been some slight reduction in 1955. The increase in the abundance and variety of planktonic indicators of inflowing water was, therefore, contemporary with some major changes in the herring fishery which are described in the preceding pages.

Some evidence of the connexion between the indicators of "mixed" water on the fishing ground and oceanic plankton proper is provided by Rae (1956) from the Continuous Plankton Recorder on the "W" route in the Atlantic west of Ireland. *Clione* and other indicator species appeared on the Records progressively earlier in each year from 1948 to 1954, but, each year, about three months before *Clione* appeared in the samples from the Buchan herring grounds (see Figure 1); Rae points out that the lag of three months is compatible with the expected rate of progression of the Atlantic drift.

At intervals of four to six weeks in 1954 and 1955, extensive surveys were made by the Scottish Home Department's research ships using the Plankton Indicator. These surveys have demonstrated that the direction of inflow may also vary; the evidence suggests that the apparent reduction of mixed water on the fishing grounds in 1955 may not have resulted so much from a diminution of the strength or intensity of the inflow as from its direction south-eastwards towards the central North Sea and away from the coastal fishing grounds. In 1954 the tongue of inflowing plankton stretched almost due south from the Shetlands, directly on to the Buchan fishing grounds.

It is notable that most of the organisms which became abundant after 1951 are important in the food of the herring and it may be significant that the increased rate of growth of the fish occurred when there was a large standing crop of their planktonic food. Nevertheless there are reasons for believing that the relation between the herring and the oceanic contribution to their environment may not be solely a direct feeding connexion (Glover, 1957).

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APPENDIX II

Recent Hydrographic Changes in the North-Western North Sea

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From hydrographic surveys of the north-western North Sea (Craig and Lovegrove, 1952, Craig, 1953—57), carried out since 1951 between March and August each year in connexion with herring investigations, the conclusion has been reached that 1952 and 1953 were the most markedly oceanic in the north-western region. The year 1954 was slightly less so, 1951 significantly less so, and 1955 the least oceanic. Both 1954 and 1955 showed recoveries of the strength of inflowing water in the latter part of the season, which brought 1954 almost to the same oceanic level as 1953 (with salinities above 35·4 $^0/_{00}$ east of Shetland in June at both surface and bottom). In 1955, even as late as August, there was no water approaching this salinity and water of 35·3 $^0/_{00}$ extended only as far as a point a little east of Fair Isle.

In support of these salinity data it may be noted that the temperature distributions up to June in 1952, 1953, and 1954 were clearly dominated by the warmth of the inflowing water, but in 1955 temperatures in the usual path of inflowing water were relatively low.

The monthly charts of surface temperature and salinity, published since 1950 by the Fisheries Laboratory, Lowestoft, and latterly by ICES, provide additional data. The surface salinity distributions in the north-western approaches to the North Sea suggest that the peak of the recent phase of oceanic activity may have been reached about January, 1953.

Surface temperature anomalies have been calculated by Smed (1946—57) for the north-western North Sea (Area F). These show that the temperatures in 1953 were, taken over the whole year, the highest recorded since 1876. Data are not available during the two wars, but indirect (wind) data suggest that high values may also have occurred during the period 1943—1945.

Broad estimates of "oceanicity", based on somewhat arbitrary estimates of heat transport southward through the north-western North Sea, from 1920 to 1955, emphasize the outstandingly continental nature of conditions during the first half of 1947, from which recovery in 1948 led to the extremely oceanic year 1949, followed by a recession to 1951. From 1951 the cycle of heat transport grew steadily to a peak in 1953 and then declined again. On these arbitrary estimates, oceanicity during 1953 was greater than in any other year of the period examined.

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3.

On the Herring of the Southern North Sea

By D. H. Cushing and A. C. Burd

Summary of Part I: The Downs Herring

The Downs herring are those which spawn in the Straits of Dover from November to January; the Bank herring spawn off the Scottish coasts and on the Dogger Bank from late July to the end of October. Hence there is an average difference in age from four to six months. Meristic differences led Heincke (1898) and Schnakenbeck (1927) to separate the stocks as races and their conclusion was supported by the statistical analysis of Schnakenbeck's results by Wollaston (1933). The existence of meristic differences which are quite consistent implies that the degree of mixing between the stocks is not great. It was, however, Bjerkan (1916) who first showed that the stocks might be separate ones; this he did by comparing the prominence of year-classes in the age distributions from different areas.

In this paper, Bjerkan's method was extended a little in that the criterion of the unity of stocks has been taken as the likeness of age distributions. The basis for this method is that a unit stock is defined as one in which the recruitment, and rates of growth and mortality are homogeneous over all its geographical range. Herring statistics do not allow rigorous tests of the homogeneity of these characteristics, but if recruitment and mortality are markedly different in different areas, the age distributions from those areas will also be different.

Despite the fact that the sampling for age may be less efficient than it might be, it was shown that there was a degree of likeness between the age distributions from the Southern Bight fisheries which contrasted markedly with the degree of difference shown between those from the Southern Bight fisheries and those from the Dogger.

Having made the distinction in this manner between the two stocks, a more detailed comparison between the East Anglian and Dogger age distributions revealed a likeness in respect of prominent year-classes which was unexpected. At most, these likenesses implied that the stocks were the same, and at least they implied that different stocks shared the same nursery grounds or the same conditions of upbringing.

The result of Höglund's tagging experiments were used to show that the number of tags returned per ton of fish caught when the fish were tagged at Bohuslän, was greater on the Dogger than at Sandettié by ten times. From this result, it was concluded that the Downs herring do not visit Bohuslän, but that the Bank herring do; this in itself is some separation of the stocks. Further, if the stocks were completely mixed, over five years one would expect roughly equal proportions of tags to turn up on each ground. As it was, two tags appeared on Sandettié as compared with 45 on the Dogger, where the catch was twice as great—so mixing takes place only to a small degree.

Summary of Part II: Natural Changes

In any East Anglian age distribution before 1950 the number/landing of four-year-old fish was nearly twice that of three-year olds. In 1950 and 1951 a change in the proportion of three- to four-year-old fish took place, so that by 1952, the number of three-year olds was much greater than the number of four-year olds.

In terms of year-classes, before 1950, the number of four-year olds was nearly twice the number of three-year olds in the previous year, showing that the recruits came into the fishery in two main parts, part as three-year olds and part as four-year olds a year later. In 1951, the number of four-year olds was only 18 % greater than the number of three-year olds in the previous year; in 1952, the proportions were equal and by 1953 the number of four-year-old fish was only half the number of three-year olds in the previous year.

At the same time as the change in the character of recruitment, an increase in length took place. The length of the three-year-old fish increased sharply in 1950 and between 1950 and 1951 it was noticed that the growth increment was higher for all age-groups than at any time before or since. Similar trends in length were observed in other Southern Bight fisheries and in the central North Sea.

From 1952—54 (and again in 1956) strong year-classes appeared as three-year-old fish in the East Anglian fishery. Each was twice as numerous as most of its predecessors and never had such a string of year-classes appeared in the East Anglian fishery. This was either a very great natural fluctuation or it was the result of a change in the nature of recruitment in 1950—51.

An analysis of l_1 records shows that before 1951 the l_1 of 4-year olds were distributed about a smaller mean than those of the three-year olds of the previous year. This is because the smaller fish of a year-class matured later and only entered the fishery as four-year olds. After 1951, there is no such difference between the l_1 distributions, presumably because the whole year-class is represented at three years old. Hence the smaller component has matured earlier; this advance in the age of maturity was associated with the increase in length which took place at the same time.

It was also shown that in addition to the sharp increase in 1950—51, there has been a slow increase in length since 1925. From an estimation of the numbers of recruits at three, four, and five years old, it was shown that there was also a slow change in recruitment, the proportion of three-year olds gradually increasing.

In 1950 it was also noticed that the numbers of *Calanus*, the preferred food of the herring, increased by two to three times. This increase was sustained at a somewhat lower level until 1954, but the numbers dropped sharply in 1956; in this year, the first decrease in length of the three-year olds was noticed.

The main effect of this change in recruitment associated with environmental changes is that the quantity of three-year olds available for catching in October is much greater. The chief consequence is that the Channel trawl fishery in 1952 started in early November, whereas in 1950 and 1951, it started in late November or early December.

As part of the three-year-old stock is exposed to fishing for a year longer, the numbers/landing of each age-group after the recruitment change was reduced as compared with those before. The degree of reduction depends on the fishing mortality; it can be obtained by comparing the numbers/landing of an age-group before the change with the numbers/landing of the age-group one year younger after the change. The percentage reduction in 1952—55 obtained in this way as compared with 1946—51 is 25—50 % and compared with 1935—38 is 10—23 %.

Summary of Part III: Changes Ascribed to Fishing

An estimate was made of the quantity of Downs herring caught in the Southern Bight. This estimate was obtained by summation of the English East Anglian catch with the corresponding Dutch and German drifter catches for October to December and with the catches by trawlers of Germany, France, Holland, and Belgium from the Southern Bight and eastern Channel.

The values obtained show that since 1952 the total Southern Bight catch has exceeded 200,000 metric tons, which total is comparable with the pre-war period 1936—38. Whereas in pre-war years this total was derived almost solely from drifters, since 1950 a greatly increasing share of the catch is now taken by trawlers fishing on the spawning grounds.

In East Anglia since the war there has been a reduction in the total catch, the number of landings, the catch per effort, and in the numbers of fish per landing in November. The degree of reduction is set out in the following Table 1.

Table 1.

East Anglia	Average number of landings	Average catch in crans	Average catch/effort (in thousands) of fish	Average numbers per landing in November (in thousands) of fish
Years				
1946—50...	7,842	378,000	63·9	70·7
1951—55...	5,960	242,000	49·4	43·9
Reduction..	24 %	36 %	23 %	38 %

The fishery in November is mainly dependent on the older age-groups so that the reduction in catch per landing represents a reduction in the numbers of older fish. The 3- and 4-year olds in the main support the October fishery. If the industrial fishing for small herring were on Downs stock alone a considerable reduction in the recruits coming to East Anglia would be expected. Comparing the period 1946—49 with 1952—55 a reduction of 6 % was found in the latter period in the numbers of recruits.

Data of the age composition of the Downs herring was presented from which instantaneous mortality coefficients were calculated. Mean values were taken for the periods, 1946—49 and 1950—55. Using the 5- and 6-year-old age data, which are fully recruited, means of 0·40 and 0·67 were obtained. Since trawling in the Channel greatly increased in 1951 the mean mortality coefficient has risen to 0·81 for the years 1952—55.

In addition to the increased catches on the spawning grounds, increased catches have been made in the Fladen, Gut, and Dogger and also in the summer

drift-net fisheries since 1951. It is thought that the Downs stock contributes in part to both northern fisheries.

Thus the increase in the total mortality coefficient occurs contemporaneously with the increase in the effort in the Downs stock.

Summary of Part IV: The Effect of Fishing on the Stock of Downs Herring

I. The industrial fishery on the eastern nursery ground and its effect on recruitment

The best estimate available gives the result that since the industrial fishery started in 1951, the recruitment in 1952—55 has been reduced by about 6 % as compared with the period 1946—49. To resolve the difficulties inherent in this sort of estimate, estimates of mortality rates in the industrial fishery are necessary, as well as estimates of numbers in the various year-classes.

II. The effect of the maturity change

The change in maturity can increase the stocks available by only a small amount, i. e., by that due to one year's natural mortality.

As more three-year-old fish are available for catching, the fishery off East Anglia has remained quite good in October. Again, the fisheries in the Northern North Sea have probably increased their yields for the same reason, that more three-year-old fish are available.

If fish are caught a little earlier in their lives, a fishery depending on older fish like the November drift-net fishery practised by the Dutch, the Germans, the English, and the Scots, will necessarily suffer in some degree, depending on total mortality.

III. The effect of fishing on the mature fish

Since 1952, the numbers per landing of 5's, 6's, and 7's have been halved and their numbers are now lower than those of pre-war years.

There are two changes associated with this:—

1. The catch of herring in the Southern Bight has increased by 30 % since 1950 due to a new trawl fishery in the region of the Straits of Dover. At the same time catches of herring in the northern and central North Sea increased considerably, as shown in the tables of catch per landing for Scottish east coast ports. As the Downs herring spawn in the region of the Straits of Dover and feed in the northern to central North Sea, great increases in the catch of this stock have apparently taken place since 1952.

2. There have been also changes in efficiency:—

(a) in the use of the echo-sounder as a search instrument in the drift-net fisheries since about 1950;

(b) in the effectiveness of bottom trawls by their rig since 1949.

In the meanwhile, the following interpretation seems the best available:— if fishing had remained at the 1946—49 level, it is possible that the maturity change would have not been noticed very much on the older fish; that the effect of the maturity change became so noticeable, because of the increased mortality, dating from 1952, and associated with high total landings. So we have reason to believe that the reduction in numbers of older fish comparing 1952—55 with 1946—51, is partly a direct effect of fishing and partly an indirect one.

General Conclusion

1. The Downs herring is a useful concept representing a possible "management unit" with greater or less exactitude.

2. There has been an advance in maturity that brings the herring into the fishery sooner in their life history and that makes an appreciable reduction in the older age-groups. But an increase in total mortality has made the reduction more noticeable.

3. The data, such as they are, indicate that fishing has also reduced the abundance of older age-groups directly.

(a) Because the reduction in recent years is more than would be accounted for by the advance in maturity.

(b) Because apparent total mortality has been relatively high in two periods of high landings, one of which, 1935—1938, was before the change in maturity.

4.

The German Herring Fisheries in the North Sea and the Biological Conditions of the Bank Herring Stock

By K. Schubert

I. The Situation in 1955

The major part of the herring landings (81·8 %) in Germany comes from the North Sea (Table 1). There are three types of fishing vessels, herring trawlers, cutters, and drifters. The bulk of the catches is landed by the trawlers (57·1 %), while the landings of the drifters amount to 22·8 %, and those of the cutters to 20·1 %.

Table 1. Total landings in 1955 (in 1000 tons)

	North Sea		Channel		Other areas[1])		Total	
	1955	1954	1955	1954	1955	1954	1955	1954
Trawlers ...	156	146	34	47	2	—	192	193
Drifters .... (Lugger)	62·4	57·9	5·8	2·7	—	—	68·2	60·6
Cutters	55	40	—	—	19	19	74	59
Total	273·4	243·9	39·8	49·7	21	19	334·2	312·6

[1]) Baltic Sea, Kattegat/Skagerak.

Trawlers

Three seasons may be distinguished; viz., in the northern North Sea during winter and spring, all over the North Sea during summer and autumn, and in the Channel during autumn and winter.

The spring fishery is concentrated on the Viking Bank, in the Utsira region and sometimes also on the Otter Bank and around the Shetlands from February to May. These landings amounted to 5,042 tons herring in 1955, having increased from 3,654 tons in 1954 as the result of increased effort.

The catch per days fishing (5·8 tons) was 30·1 % lower than in the previous season. This decline was brought about chiefly by poor results off Utsira, where the catch per day decreased from 10·5 to 4·8 tons.

In the summer/autumn fishery in the North Sea the trawlers frequented the Bressay/Fladen area, the Gut and the Dogger Bank area during the period June to November.

The fishery started about mid-June on the Fladen and was carried out for 100 days until the beginning of October (84 days in 1954). The trawlers made 689 trips (1954 = 364) into this area and the total yield amounted to 104,951 tons or over 100 % more than in 1954 (50,031 tons). The catch per day's fishing increased from 15·0 to 18·8 tons.

The fishing on the Gut took place from the end of July until October and lasted 70 days (40 in 1954). The total yield dropped from 11,466 tons (1954) to 8,495 tons (about 25·9 %). The catch per day's fishing also showed a decline from 18·7 to 14·1 tons.

In the Dogger Bank area the fishery commenced in September and continued until November (63 days as against 87). 300 trips were made as against 532 in 1954. The total yield in this area decreased from 79,087 to 37,417 tons (about 52·7 %). The catch per day also showed a decline from 16·5 to 14·6 tons.

In spite of the reduction of the yields in two fishing areas, the total yield of the German herring trawl fishery in the season 1955 in the North Sea increased (compared to 1954) from 140,584 to 150,863 tons, the number of trips from 1029 to 1134 and the catch per day from 16 to 16·2 tons. This rise is mainly due to the long and favourable fishing period on the Fladen.

The season in the Channel takes place from November to January, but in 1955 the fishing came already to an end in December. Altogether 265 trips were made as against 388 in 1954. The total yield was 33,750 tons (47,008 tons). The catch per day was the same as in 1954, 14·0 tons. In November most of the catch came from Sandettié, in December from Dieppe-Boulogne. In the Sandettié area the catch per day amounted to 15·0 tons (13·7), at Dieppe 16·1 tons (12·5), and off Boulogne 10·6 tons (20·7).

Drifters

In order to market fresh herring, a part of the German drifters has worked in the northern North Sea from March to June during recent years. Afterwards, from June to November, fishing is carried out on the usual grounds of the western and southern North Sea, and, in November and December, in the Channel.

In 1955 a total of 3,544 tons were landed fresh

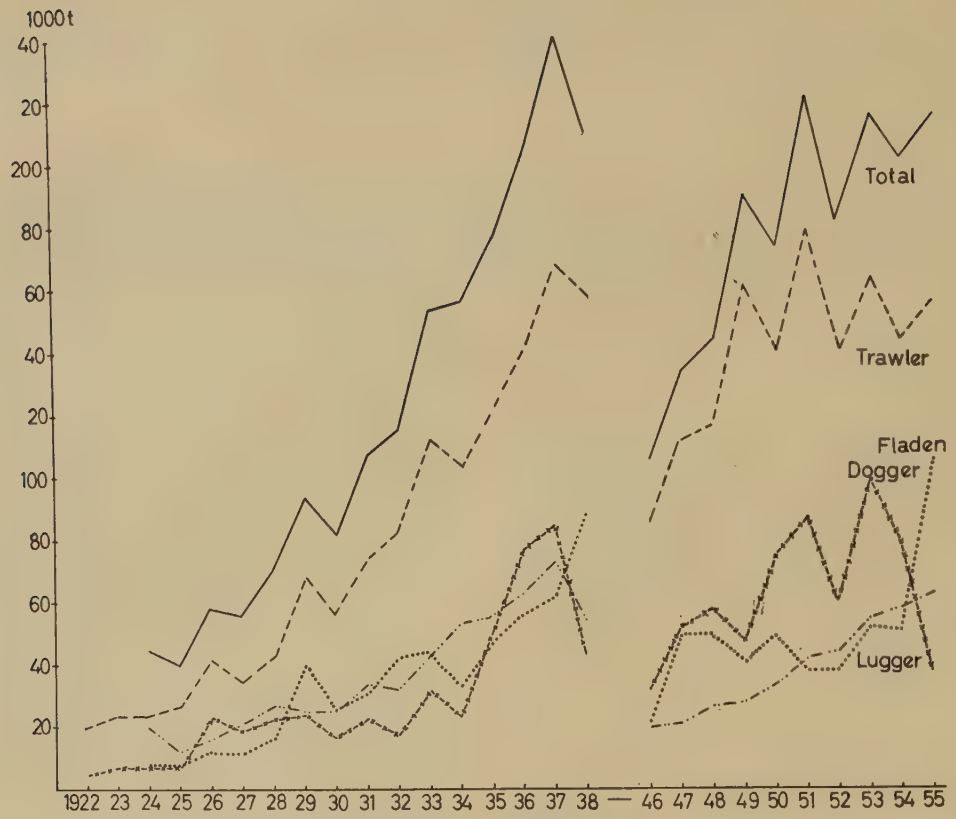

Figure 1. German herring landings.

(1954 = 2,949 tons). For these landings the catch per day's fishing was 4·6 tons (4·5). For the most part the fresh herring, landed by the drifters, is caught by drift-net. Only 15 % were caught by trawl in 1955, the proportion being slightly higher during summer and autumn than during spring.

The landings of salted herring from drifters amounted to 56,154 tons (1954 = 53,696). The number of landings was somewhat smaller (606 against 636). The catch per day, on the other hand, increased slightly (4·4 against 4·3 tons).

It may be mentioned that the season lasted longest on the northern grounds (Fladen, Gut, and Long Forties). The number of fishing days increased from 1624 (1954) to 2436 on the Fladen Ground, the corresponding increase being from 1768 to 4102 for the Gut/Long Forties. Great increase in the total yields could be noted both for the Fladen Ground (3,972—15,409 tons) and for the Gut/Long Forties (6,737—20,795 tons), while in the Dogger area the yields diminished from 26,586 to 10,389 tons. Finally, the catch per day showed a strong increase from 2·2 to 6·2 tons (drift-nets) and from 5·6 to 7·5 tons (trawl and drifters) on the Fladen Ground, whereas in the Gut/Long Forties and Dogger area a decrease was observed. The corresponding figures for the Gut were 3·4—3·2 tons (drifters) and 7·8—6·3 tons (trawlers), and for the Dogger area 4·9—3·1 tons (drift-net) respectively 8·1—6·1 tons (trawl).

The Southern Bight showed also a strong decline in number of fishing days, in total yield, and catch per effort (5·9—3·5 tons). In the Channel fishery the number of trips increased from 54 to 96. The total yield was 5,817 tons as against 2,657 tons in 1954, and the number of fishing days 1820 (875). The catch per day was 3·6 tons against 2·8 for the drift-nets and 4·8 tons against 5·5 for the trawls.

Cutters

Fishing by means of trawl is carried out both for marketing and for processing as well in the open sea as in coastal waters. During winter the fishing is concentrated in the German Bight and in the summer months in the open North Sea. During midsummer some vessels fish for young herring by means of trawl and pair-trawls. The total output of this fishery increased from 627 tons (1954) to 1537 tons (1955) of herring for human consumption and from 39,361 to 53,760 tons for industrial purposes.

II. Survey of the German Herring Statistics in the North Sea

The development of the German herring trawling in the North Sea from 1922—1938 shows a strong increase up to 1937, when the peak was reached (Fig. 1). The same trend is to be seen in the lugger fishery also. After World War II a similar development is witnessed: a strong increase of the trawl catches up to 1951 with a new peak, and then from this year onward a slight decrease until 1955. The rise in the total yields in the lugger fishery is not so strong but more regular.

The increase before and after the war in the trawl and lugger fishery is mainly to be ascribed partly to the enlargement and partly to the renewal of the fleet. Figure 1 shows the landings of the trawlers for two important fishing areas in the North Sea from 1922—24 to 1955. The peaks in 1937, 1951, and 1953 were caused by good catches in the Dogger area. Figure 2 shows that the bulk of the landings of the trawlers in the North Sea normally come from the Dogger area (41—63 %), while the corresponding figures for the Fladen area are 30—46 % of the total yield. It was different only in 1938 and 1955, when the seasons on the Dogger area failed. In these years

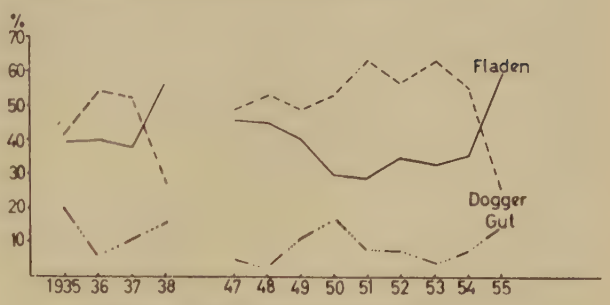

Figure 2. German herring landings in %.

Table 2. Average catch in tons per fishing day of trawlers (herring only).

	1946	47	48	49	50	51	52	53	54	55
Total	15·2	13·6	11·0	11·9	12·0	14·4	16·7	17·8	16·0	16·2
Fladen Gr.	16·4	15·3	12·3	10·8	13·4	13·0	16·4	16·2	15·0	18·8
Dogger Bank	13·5	12·5	10·0	12·7	10·8	15·1	17·4	20·2	16·5	14·6

the Fladen area produced the main catch with 57 and 60 % of the total yield. In 1954 the catches were lower than in 1953 but still remained within normal ranges.

The calculated catch per fishing day (Table 2) shows much better the situation of herring trawling. Also here a general increase may be ascribed to the modernization of the fleet. The maximum of the catch per day was reached in 1953 with 17·8 tons for the whole North Sea, the Dogger attaining the remarkable peak of 20·2 tons. Then the average catch decreased in the south. In 1955 there were exceptionally good catches on the Fladen Ground (18·8 tons per day). From this evidence the conclusion was drawn, that the herring which had failed to appear on the Dogger Bank could be caught in the northern North Sea.

III. The Biological Conditions of the Bank Herring Stock

The Bank herring forms the bulk in the German herring fishery in the North Sea. The meristic characters according to the German investigations are: VS = 56·45—56·50, K_2 = 14·74—14·93, Rf[1]) = 45.5—45·9. These values are found in the Fladen as well as in the Dogger area, in the pre-spawning communities and in the spent Bank herring from the Scottish east coast, and on the spawning places on the Dogger. In the area between these two places, however, (Gut to English east coast) clearly different vertebral counts are found.

This seems to be brought about by an admixture of Downs herring to the Bank herring stock. It is well known that the Downs herring has a higher average number of vertebrae and a lower number of keeled scales than the Bank herring. Splitting the samples according to maturity stages we get an average number of vertebrae of 56·60 for stage III, 56·53 for stage IV, and 56·45 for stage V. Evidently Downs herring which spawn later in the year prevail among stage III, and Bank herring among stage V, while there are about equal proportions in stage IV.

In addition, there is a small amount of admixture from spring herring (stages I/II) in the Fladen and Gut catches. The average number of vertebrae shows a higher value for stages I/II in these areas (Table 3).

Since 1922, with some breaks in the years 1933,

Table 3. Stages of maturity in relation to number of vertebrae in 1955

Maturity	Fladen Ground		Gut		Dogger Bank	
	Number	Average	Number	Average	Number	Average
Immature	102	56·72	18	56·67	45	56·49
II	190	56·72	40	56·70	59	56·47
III–VI	498	56·49	409	56·52	318	56·52
VII/II	72	56·42	156	56·51	160	56·43
	862	56·55	623	56·53	582	56·47

1937—1944, and 1951—1952 Ehrenbaum, Schnakenbeck, Lissner, Erdmann, and others collected a rather comprehensive material concerning the age composition of the catches. A comparison of the age composition between Fladen Ground and Dogger catches in pre-war years shows some general similarities. Rather conspicuous differences are met with

[1]) Gill-raker counts.

only in the years 1924, 1930, and 1955. But generally the average age of the herring is higher on the Fladen by about one year, and therefore older year-classes will be represented in higher percentages than on the Dogger Bank. Year-classes will appear earlier on the Dogger Bank, but will play an important role for a longer period on the Fladen (see the 1922 year-class in 1930 and even in 1932).

The 1927 year-class was scarce on the Scottish N.E. coast and on the Fladen in 1930, but on the Dogger this class was relatively strong (Fig. 3). In 1931 it was predominant both on the Dogger and the Fladen. From 1932 until 1936 it was relatively stronger on the Fladen than on the Dogger. This would mean, that the older herring prefer the Fladen Ground, or more strictly, the spawning places in its vicinity.

The age composition (Fig. 4) after the second world war shows a high average age on the Dogger (5·6 years) and the Fladen (6·3 years) in 1946. In 1949 the new strong 1946 year-class appears, giving rise to a rejuvenescence of the stock. During the following years the mean age increased, because the new year-classes were not so strong. In 1955 a rejuvenescence occurred once more caused by the appearance of the very strong year-class of 1952.

The age composition of the stock on the Fladen contains many strong or at least average-sized broods while there are only some few weak year-classes. From 1922—1955 the following broods were important:— 1917, 1918, 1921, 1922, 1924, 1927, 1929, 1930, after the war 1939, 1940, 1941, 1942, 1943, 1945, 1946, 1949, 1950, 1951, and 1952. The year-classes of 1920, 1923, 1925, 1926, 1944, 1947, 1948 were insignificant only.

On the Dogger the proportion of successful year-classes is still greater, only 1923, 1925, 1933, 1943, and 1948 were poor.

Generally a good year-class has a decisive influence on the composition of the catches for 3 years while it is more or less traceable in the stock for 10 years. Strong new year-classes will make up fairly large

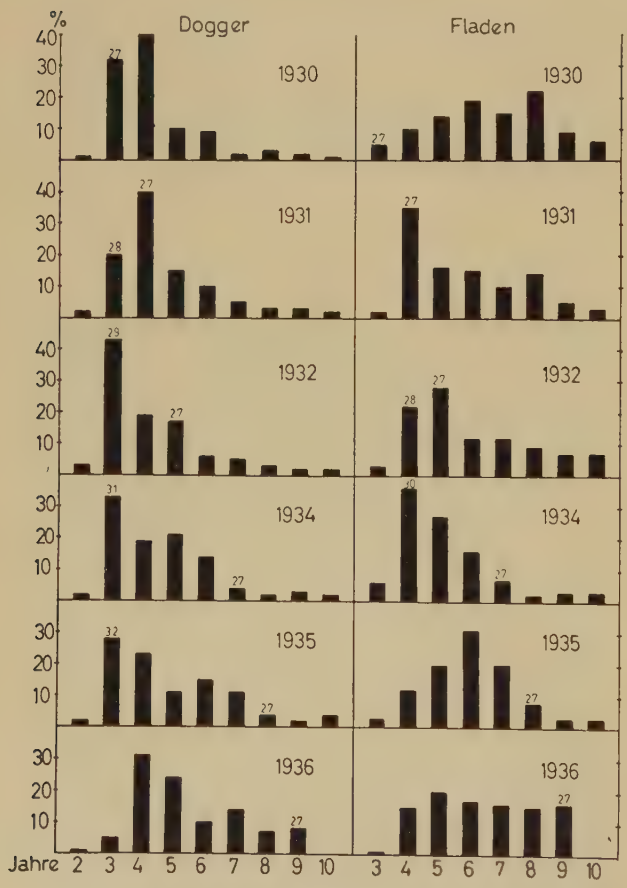

Figure 3. Age composition 1930—36 on the Dogger and Fladen.

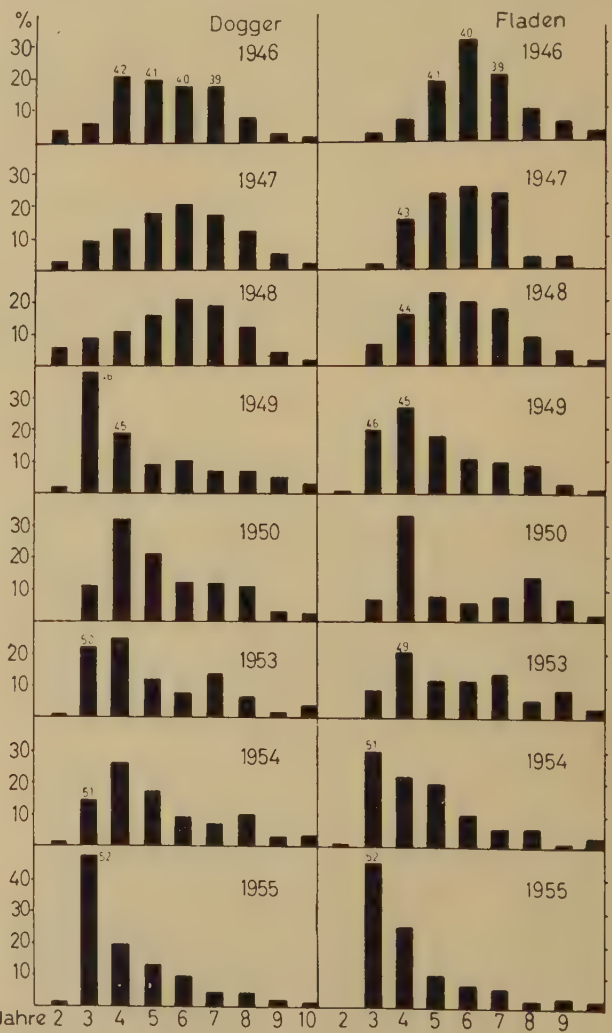

Figure 4. Age composition 1946—55 on the Dogger and Fladen.

proportions of the catches up to 6 years, as was the case for the brood of 1922. Rejuvenescence and senescence affect the picture of the catch composition. Recruitment may be of varying strength, and will not be coincident on Dogger and Fladen. On the Dogger recruits will appear annually in general, though there may be intervals of poor recruitment of two or three years. On the Fladen intervals of poor recruitment will occur more often.

Taking into account the interchange between the Fladen and the Dogger herring populations it may be stated that generally the recruitment of the Bank herring stock is very regular and abundant, with few exeptions. Changes in the yield of the fisheries in the past may be attributed to natural causes, among which the fluctuations in the strength of the year-classes seem to be of outstanding importance.

In earlier years it has been generally found that the catches on the Dogger Bank mainly consisted of 3-year-olds and older and those on the Fladen of 4-year-olds and older. Not until 1954 (and in an even more pronounced degree in 1955) was it experienced that 3-year-old herrings predominated also in the northern North Sea and were present there in a larger proportion than on the Dogger. It is remarkable that this phenomenon coincides with the onset of the decline in the landings on the Dogger. In 1955 the investigation of the hydrographical conditions in August through the R/S "Anton Dohrn" showed an unusual situation in the North Sea. The two centres of winterly bottom water on the Fladen Ground, Bressay Shoal, and on the Gut were unusually cold in this year. This may be explained as an after-effect of the cold spring. The thermocline after the summer heating had preserved the cold water in the lower layers. The distribution of salinity was also very unusual, water containing 35 ‰ S and more covering a larger area of the bottom than is normally the case (Fig. 5). Water of high salinity and low temperature covered even the northern border of the Dogger Bank. Perhaps these special hydrographical conditions in 1955 may have been the cause of the phenomenon, that in this year the recruit spawners were predominant on the Fladen.

Still another fact must be mentioned here. In 1953 the spawning took place on various places on the Dogger just inside the 40 m. line. Towards the end of August and beginning of September the spawning was observed on the N.W. of the area. About the middle of September until October the spawning shifted from the N.W. to the W. Dogger (Bruceys Garden) and later on (middle of October) farther to the S.W. and S. Investigations of the stomach contents of herring proved that spawning took place in these areas. Nearly 10 % of the herring stomachs investigated in the different areas were filled with herring spawn. Hydrographical observations in the areas showed 12·5—13·5° C. and 34·6—34·8 ‰ salinity. In 1955 and 1956 spawning was only observed in the S.W. area from the end of September to middle October, where temperatures about 12° C. prevailed, while a cooler water body (9—10° C.) was found near the bottom of the area at the 40 m. line in the N.W. and W. The same hydrographical situation was found in the middle of September 1956 in the N. and N.W. Dogger. In this year the temperatures on the bottom were still lower than in 1955 (8—10° C.) presumably as a result of the very cold spring. From these facts it is assumed that special hydrographic conditions may guide the recruit spawners and occasionally prevent the onset of the spawning in some of these years.

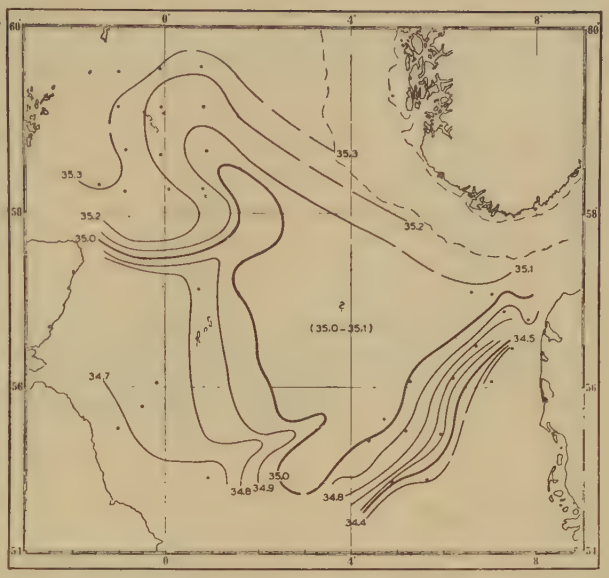

Figure 5. Bottom salinity 28.7.—25.8.1955 (after Dietrich).

A review of the stock investigations shows that the 3-year-old fish dominated in 1955 (the 1952 year-class); but in 1956 this year-class formed a still greater part of the catches because the following year-class (1953) was relatively weaker. A similar age composition as in 1956 existed in 1922 and 1925.

The failure of the fishery for Bank herring in 1955 and 1956 on the Dogger was, in our opinion, caused by unfavourable natural factors. Unfortunately two of these acted simultaneously. We need not fear that either of these unfavourable conditions will occur soon again. It is still less likely that they once more will coincide, as they did in 1956.

5.

Evolution dans le Temps et dans l'Espace de la Composition des Concentrations de Harengs Exploitées par les Pêcheurs Belges dans la Mer du Nord au Cours de la Période 1951–1955

Par Ch. Gilis

I. Déplacement de la Pêche

La pêche belge aux harengs dans la Mer du Nord se déplace du nord vers le sud:—

1. En juillet et août elle s'effectue dans la région septentrionale, principalement au Fladen et Long Forties.

2. En septembre et octobre dans la région centrale, particulièrement au Old Devils Hole, Gut, Brucey's Garden et Dogger Bank.

3. De novembre à février dans la région méridionale, notamment aux Hinders, Sandettié et Varne.

II. Evolution de la Composition des Concentrations de Harengs Exploitées

1. Région septentrionale

Dans les échantillonnages provenant de la région septentrionale en juillet et août, on observe tous les stades de maturité, soit I à VIII—II.

Comme la présence de tous les stades de maturité indique un mélange de différents groupes ou populations de harengs, nous avons tâché de les distinguer à l'aide de la moyenne vertébrale. Ainsi on a pu scinder la matériel en deux grands groupes: un premier groupe avec une moyenne vertébrale de 56·75, caractéristique des "Harengs de Printemps" et un second groupe avec une moyenne vertébrale de 56·50, caractéristique des "Harengs d'Automne".

Les Harengs de Printemps comprennent les individus aux stades I + II (56·82), VI (56·75) et VII + VIII—II (56·65) donc tous des harengs nettement polyspondyliques, tandis que les Harengs d'Automne comprennent les individus aux stades III (56·60), IV (56·53) et V (56·43). Il se fait donc que les harengs aux stades III et IV sont polyspondyliques et ceux au stade V oligospondyliques. Ceci nous permet de distinguer deux sous-groupes ou populations: les "Harengs des Downs" (stade III) et les "Harengs du Dogger Bank" (stade V), tandis que les harengs au stade V, dont la moyenne vertébrale constitue une valeur intermédiaire entre les harengs du Dogger Bank et ceux des Downs, pourraient bien être un mélange des deux populations.

2. Région centrale

Dans les échantillonnages de septembre les Harengs de Printemps semblent faire défaut, alors qu'on y retrouve les Harengs du Dogger Bank et les Harengs des Downs.

Les Harengs du Dogger Bank y sont représentés par les individus aux stades I + II (56·48), VI (56·51) et VII + VIII—II (56·48) soit pour l'ensemble des stades 56·49.

Les Harengs des Downs sont représentés par les individus aux stades III (56·59) et IV (56·60) soit 56·60 pour les deux stades.

Comme la moyenne vertébrale des individus au stade V (56·51) constitue une valeur intermédiaire, il est probable qu'il s'agit d'un mélange des deux populations.

Dans les échantillonnages d'octobre, nous distinguons également les deux populations. Celle du Dogger Bank comprend les harengs aux stades I + II (56·00), VI (56·50) et VII + VIII—II (56·44) soit 56·49 pour l'ensemble de cette population.

La population des Downs est représentée par les harengs au stade IV (56·58).

La moyenne vertébrale des individus au stade V étant encore une valeur intermédiaire (56·52), il faut admettre qu'ils forment encore un mélange des deux populations.

Tableau 1.

	Hareng des Downs		Dogger+ Downs	Harengs du Dogger			Harengs de Printemps		
Juillet-Août									
Nombre: 1,695									
Stade de maturité	III		IV	V			VI	VII+ VIII-II	I+II
% total	17·7		35·6	37·9			0·2	2·6	6·0
Moy. vertébrale	56·60		56 53	56·43			56·75	56·65 56·75	56·82
Age	4·6		5·8	7·2			5·0	6·3	3·4
Septembre									
Nombre: 1,896									
Stade de maturité	III	IV	V	VI	VII+ VIII-II	I+II	—	—	—
% total	4·5	15·6	45·6	20·5	8·4	5·4	—	—	—
Moy. vertébrale	56·59 56·60	56·60	56·51	56·51	56·48 56·49	56·48	—	—	—
Age	3·9	4·0	5·5	6·4	5·6	4·1	—	—	—
Octobre									
Nombre: 1,468									
Stade de maturité	IV		V	VI	VII+ VIII-II	I+II			
% total	2·9		38·0	40·8	11·9	6·4	—	—	—
Moy. vertébrale	56·58		56·52	56·50	56·44 56·49	56·0	—	—	—
Age	4·9		5·8	6·7	6·2	2·8	—	—	—
Novembre									
Nombre: 775									
Stade de maturité	V		VI	VII+VIII-II		I+II	—	—	—
% total	46·6		34·2	17·7		1·5	—	—	—
Moy. vertébrale	56·61		56·53	56·46	56·46	56·42	—	—	—
Age	4·8		4·7	4·4		3·5	—	—	—
Décembre									
Nombre: 1,468									
Stade de maturité	—		VII+VIII-II	—		—	—	—	—
% total	—		90·0	—		—	—	—	—
Moy. vertébrale	—		56·57	—		—	—	—	—
Age	—		5·2	—		—	—	—	—
Janv.-Févr.									
Nombre: 2,829									
Stade de maturité	VII+VIII-II		—	—		—	—	—	—
% total	97·0		—	—		—	—	—	—
Moy. vertébrale	56·60		—	—		—	—	—	—
Age	5·2			—		—	—	—	—

3. Région méridionale

En novembre les deux populations sont encore présentes dans les échantillonnages.

Celle du Dogger Bank comprend les harengs aux stades I + II (56·42) et VII + VIII—II (56·46), pour l'ensemble 56·46.

Dans la population des Downs on compte les harengs au stade V (56·61).

La moyenne vertébrale des harengs au stade VI, soit 56·53, semble indiquer un mélange des deux populations.

En décembre 90 % des harengs observés sont aux stades VII et VIII—II avec 56·57 comme moyenne vertébrale. Comme cette moyenne est inférieure à celle constatée en novembre chez les Harengs des Downs, il est possible qu'il reste encore une faible portion des Harengs du Dogger Bank.

En janvier et février 97 % des harengs sont guais (VII et VIII—II). Leur moyenne vertébrale est portée à 56·60 contre 56·57 seulement en décembre. Cette légère augmentation signifie, l'élimination totale des Harengs du Dogger Bank, ou la présence d'une portion minime des Harengs de la Manche, dont la moyenne vertébrale est légèrement supérieure à celle des Harengs des Downs.

Tableau 2. **Pêche aux harengs dans la Mer du Nord.**

(Age: fréquence pour 1000 de chaque âge observé)

Hg = hareng guais
Hp = hareng plein

S = région septentrionale
C = région centrale
M = région méridionale.

		Détail	Age (Ans) 2	3	4	5	6	7	8	9	10	+10	Nombre
1930—31													
Janv.	M	Hg	3	144	184	146	200	102	173	35	11	2	625
Févr.	M	Hg	8	331	299	102	89	57	67	33	10	4	508
1931—32													
Janv.	M	Hg	—	85	260	185	108	148	65	96	36	17	520
Févr.	M	Hg	—	96	151	121	85	121	85	226	65	50	199
1932—33													
Déc.	M	Hg	—	261	143	126	98	67	115	56	64	70	357
Janv.	M	Hg	2	247	127	229	134	57	94	35	38	37	598
1933—34													
Déc.	M	Hg	24	41	431	73	65	82	24	163	24	73	123
Janv.	M	Hg	4	20	371	62	108	83	57	143	40	112	455
Févr.	M	Hg	2	35	525	105	151	72	24	33	22	31	543
Mars	M	Hg	3	28	627	96	133	52	12	22	15	12	324
1934—35													
Déc.	M	Hg	—	164	48	480	60	88	76	36	32	16	250
Janv.	M	Hg	—	300	57	407	68	76	33	24	24	11	457
Févr.	M	Hg	—	251	60	367	72	89	59	19	45	38	471
1935—36													
Déc.	M	Hg	—	161	226	40	342	30	60	71	35	35	199
Janv.	M	Hg	—	248	272	48	246	46	59	25	20	36	646
Févr.	M	Hg	—	345	320	18	163	25	61	18	16	34	446
1936—37													
Déc.	M	Hg	—	88	351	162	27	230	54	34	14	40	148
Janv.	M	Hg	—	164	283	164	19	218	40	57	24	31	421
Févr.	M	Hg	—	306	306	143	—	82	61	41	20	41	49
1937—38													
Déc.	M	Hg	—	203	135	311	95	54	149	13	13	27	74
Janv.	M	Hg	4	274	115	166	121	18	192	24	44	42	496
1938—39													
Déc.	M	Hg	—	57	248	170	199	177	36	99	—	14	141
Janv.	M	Hg	—	90	434	71	117	85	7	133	9	53	435
1939—40													
Janv.	M	Hg	—	160	220	300	70	100	80	10	60	—	100
1941—42													
Févr.	M	Hg	13	227	147	227	147	120	80	13	13	13	75
Mars	M	Hg	8	184	88	368	152	120	40	16	8	16	125
Avril	M	Hg	—	440	80	440	40	—	—	—	—	—	25
1942—43													
Déc.	M	Hg	—	71	121	111	263	192	162	50	20	20	99
Janv.	M	Hg	—	14	267	103	260	157	164	7	21	7	146
Févr.	M	Hg	—	8	323	89	355	97	56	56	8	8	124
Mars	M	Hg	—	48	308	89	329	110	82	20	7	7	146
1943—44													
Déc.	M	Hg	—	101	51	136	136	263	126	126	41	10	198
Janv.	M	Hg	—	100	32	213	64	305	125	125	16	20	249
Févr.	M	Hg	—	90	20	170	80	345	160	90	15	30	200
Mars	M	Hg	—	60	—	200	40	400	220	80	—	—	50
1944—45													
Déc.	M	Hg	7	61	129	20	135	128	331	135	47	7	148
Janv.	M	Hg	—	100	88	16	200	52	296	136	92	20	250
Févr.	M	Hg	—	134	113	13	240	67	300	67	33	33	150

Tableau 2 (suite).

Détail			Age (Ans) 2	3	4	5	6	7	8	9	10	+10	Nombre
1945—46													
Déc.	M	Hg	5	245	140	60	15	150	55	165	105	60	200
Janv.	M	Hg	-	186	156	81	30	171	55	226	60	35	199
Févr.	M	Hg	-	186	116	91	40	176	60	221	60	50	199
Mars	M	Hg	—	450	70	40	20	160	60	90	70	40	100
1946—47													
Août	S	Hp	—	18	69	117	215	168	128	150	88	47	274
Août	C	Hp	—	46	46	364	91	227	136	45	45	—	22
Sept.	S	Hp	—	47	70	46	419	93	46	46	140	93	43
Sept.	C	Hp	21	96	159	97	269	110	83	83	34	48	145
Déc.	M	Hg	13	125	113	38	79	50	163	71	226	121	239
Janv.	M	Hg	-	53	102	94	66	33	250	6	197	119	246
Févr.	M	Hg	9	121	154	88	102	19	223	23	172	88	215
1947—48													
Août	SC	Hp	—	64	139	238	169	139	70	76	35	70	172
Sept.	SC	Hp	—	42	42	90	125	250	152	160	42	97	144
Déc.	M	Hg	—	195	124	154	47	47	24	142	83	184	169
Janv.	M	Hg	—	109	93	169	106	100	34	177	37	175	378
Févr.	M	Hg	—	41	61	177	89	61	75	231	68	197	147
1948—49													
Août	SC	Hp	—	6	127	91	212	146	206	115	24	73	165
Sept.	SC	Hp	—	—	205	123	178	137	96	96	55	110	73
Oct.	CM	Hp	—	60	240	60	60	200	140	40	100	100	50
Déc.	M	Hg	3	93	69	35	93	108	90	96	168	244	344
Janv.	M	Hg	3	90	116	81	215	113	96	57	116	113	335
Févr.	M	Hg	—	100	177	62	196	65	100	54	104	142	260
1949—50													
Août	S	Hp	—	—	26	135	129	202	218	171	83	36	193
Sept.	S	Hp	—	42	55	55	125	139	181	250	111	42	72
Sept.	C	Hp	—	17	35	158	53	263	140	158	88	88	57
Oct.	C	Hp	-	98	186	124	113	180	62	129	57	51	194
Déc.	M	Hg	—	178	206	87	63	87	79	63	79	158	253
Janv.	M	Hg	—	125	213	62	44	163	137	69	50	137	160
Févr.	M	Hg	—	239	169	70	25	139	60	85	74	139	201
1950—51													
Août	S	Hp	—	155	330	82	62	82	144	72	52	21	97
Août	C	Hp	-	20	133	112	102	133	133	184	102	81	98
Sept.	C	Hp	-	162	361	207	72	36	18	27	36	81	111
Oct.	C	Hp	—	67	286	177	76	109	32	25	76	92	119
Déc.	M	Hg	-	130	254	203	79	79	102	57	45	51	177
Janv.	M	Hg	—	214	193	172	88	52	104	62	42	73	192
1951—52													
Août	S	Hp	—	24	106	200	200	153	94	70	82	71	85
Sept.	C	Hp	—	46	246	492	108	—	—	31	31	46	65
Oct.	C	Hp	-	36	157	265	217	97	60	96	48	24	83
Déc.	M	Hg	-	104	281	198	209	104	52	31	—	21	96
Janv.	M	Hg	-	206	245	269	108	49	44	49	10	20	204
Févr.	M	Hg	11	233	280	223	140	62	10	31	—	10	193
1952—53													
Juil.	S	Hp	—	—	68	102	137	125	159	68	102	239	88
Août	S	Hp	-	32	65	32	194	129	129	129	161	129	31
Août	C	Hp	—	75	226	151	340	132	—	19	—	57	53
Sept.	C	Hp	—	236	200	143	225	93	25	11	36	32	280
Oct.	C	Hp	—	100	64	164	127	209	91	100	73	73	110
Déc.	M	Hg	4	406	122	111	118	97	57	32	39	14	279
Janv.	M	Hg	19	342	126	190	123	94	35	16	23	32	310

Tableau 2 (suite).

	Détail		Age (Ans) 2	3	4	5	6	7	8	9	10	+10	Nombre
1953—54													
Août	S	Hp	—	91	210	124	120	139	57	91	72	96	209
Août	C	Hp	—	159	333	152	91	152	30	30	23	30	132
Sept.	C	Hp	4	318	215	95	73	117	73	29	36	40	274
Oct.	C	Hp	11	152	238	141	89	156	78	15	34	86	269
Nov.	M	Hp	—	230	267	143	87	137	93	12	25	6	161
Déc.	M	Hg	10	265	217	146	135	104	74	23	13	13	309
Janv.	M	Hg	3	221	204	126	121	161	89	32	20	23	348
Févr.	M	Hg	—	428	245	82	82	54	68	14	14	14	147
1954—55													
Août	S	Hp	46	235	267	129	64	83	74	51	23	28	217
Sept.	C	Hp	4	168	347	156	69	46	88	42	15	65	262
Oct.	C	Hp	27	107	160	178	111	93	107	35	40	142	225
Nov.	M	Hp	10	446	270	64	73	44	39	10	24	20	204
Déc.	M	Hg	3	250	224	123	84	75	104	78	33	26	308
Janv.	M	Hg	9	332	214	115	78	74	87	47	16	28	322
Févr.	M	Hg	—	159	180	164	122	148	127	58	21	21	189
1955—56													
Août	C	Hp	—	167	250	118	146	49	62	104	7	97	144
Sept.	C	Hp	–	143	137	58	117	91	84	143	65	162	154
Oct.	C	Hp	—	229	199	66	90	78	60	115	36	127	166
Nov.	M	Hp	—	237	290	162	125	74	47	34	24	7	296
Déc.	M	Hg	—	212	331	110	76	68	93	59	34	17	118
Janv.	M	Hg	—	135	241	190	114	89	71	98	49	13	369
Févr.	M	Hg	10	276	199	209	97	41	66	46	31	25	196

Tableau 3.

Pêche Belge aux harengs dans la Mer du Nord
Effort de pêche par mois et par régions.

S = région septentrionale
C = région centrale
M = région méridionale

Hg = hareng guais
Hp = hareng plein
pan. = chalut à panneaux
pél. = chalut pélagique

Année et Mois	Détail			Nombre de jours de pêche	Poids total débarqué (tonnes)	Prise moyenne par jour de mer		Prise moyenne par 100 HP × C.V.	
						Kg.	Individus	Kg.	Individus
1930—31									
Janv.....	M	Hg	pan.	994	9,551	9,569	100,726	—	—
Févr.....	M	Hg	pan.	1,208	8,849	7,326	96,395	—	—
1931—32									
Janv.....	M	Hg	pan.	482	2,605	5,404	55,711	—	—
Févr.....	M	Hg	pan.	166	781	4,706	49,021	—	—
1932—33									
Déc.....	M	Hg	pan.	159	865	5,440	59,780	—	—
Janv.....	M	Hg	pan.	433	1,808	4,176	45,391	—	—
1933—34									
Déc.....	M	Hg	pan.	55	138	2,507	24,087	—	—
Janv.....	M	Hg	pan.	325	1,926	5,925	56,429	—	—
Févr.....	M	Hg	pan.	364	4,045	11,113	119,495	—	—
Mars	M	Hg	pan.	138	1,346	9,752	110,818	—	—
1934—35									
Déc.....	M	Hg	pan.	53	347	6,551	61,802	—	—
Janv.....	M	Hg	pan.	422	5,068	12,011	125,114	—	—
Févr.....	M	Hg	pan.	361	6,817	18,884	190,747	—	—
1935—36									
Déc.....	M	Hg	pan.	110	966	8,783	75,716	—	—
Janv.....	M	Hg	pan.	441	5,147	11,671	109,075	—	—
Févr.....	M	Hg	pan.	222	2,483	11,184	116,500	—	—
1936—37									
Déc.....	M	Hg	pan.	98	493	5,034	44,549	—	—
Janv.....	M	Hg	pan.	299	2,481	8,298	75,436	—	—
Févr.....	M	Hg	pan.	31	158	5,097	53,094	—	—
1937—38									
Déc.....	M	Hg	pan.	8	42	5,306	44,966	—	—
Janv.....	M	Hg	pan.	137	765	5,584	48,982	—	—
1938—39									
Déc.....	M	Hg	pan.	66	573	8,678	71,719	—	—
Janv.....	M	Hg	pan.	189	1,273	6,736	60,143	—	—
1941—42									
Déc.....	M	Hg	pan.	334	829	2,479	24,068	—	—
Janv.....	M	Hg	pan.	1,166	4,538	3,892	38,920	—	—
Févr.....	M	Hg	pan.	644	3,252	5,049	57,375	—	—
Mars	M	Hg	pan.	216	1,399	6,475	69,624	—	—
1942—43									
Déc.....	M	Hg	pan.	2,494	9,267	3,716	34,729	—	—
Janv.....	M	Hg	pan.	2,714	20,368	7,505	72,163	—	—
Févr.....	M	Hg	pan.	2,442	16,627	6,809	68,090	—	—
Mars	M	Hg	pan.	1,515	5,633	3,718	38,729	—	—
1943—44									
Déc.....	M	Hg	pan.	2,760	15,225	5,516	49,694	—	—
Janv.....	M	Hg	pan.	3,148	23,185	7,365	68,832	—	—
Févr.....	M	Hg	pan.	2,560	14,692	5,739	53,636	—	—
Mars	M	Hg	pan.	911	5,018	5,509	52,971	—	—
1944—45									
Déc.....	M	Hg	pan.	990	6,239	6,302	60,596	—	—
Janv.....	M	Hg	pan.	1,586	11,612	7,322	73,220	—	—
Févr.....	M	Hg	pan.	1,313	13,995	10,659	111,031	—	—

Tableau 3 (suite).

Année et Mois	Détail			Nombre de jours de pêche	Poids total débarqué (tonnes)	Prise moyenne par jour de mer		Prise moyenne par 100 HP × C.V.	
						Kg.	Individus	Kg.	Individus
1945—46									
Nov.	M	Hg	pan.	500	413	826	7,792	—	—
Déc.....	M	Hg	pan.	1,976	6,300	3,188	30,075	—	—
Janv.....	M	Hg	pan.	1,869	9,792	5,239	46,777	—	—
Févr.....	M	Hg	pan.	1,223	5,747	4,699	42,333	—	—
Mars	M	Hg	pan.	962	4,107	4,269	46,402	—	—
1946—47									
Juil.....	S	Hp	pan.	7	55	7,888	46,675	106	627
Août	SC	Hp	pan.	216	2,618	12,122	76,722	258	1,633
Sept.....	SC	Hp	pan.	592	5,198	8,780	61,831	206	1,451
Oct.....	C	Hp	pan.	427	2,725	6,382	49,859	128	1,000
Nov.	C	Hp	pan.	187	291	1,557	12,975	22	183
Nov.	M	Hp	pan.	10	53	5,342	50,396	127	1,198
Nov.	M	Hg	pan.	360	238	6,609	57,470	77	670
Déc.....	M	Hp	pan.	36	30	8,389	72,948	117	1,017
Déc.....	M	Hg	pan.	1,691	6,155	3,640	31,652	379	3,296
Janv.....	M	Hg	pan.	2,188	11,880	5,430	46,810	612	5,276
Févr.....	M	Hg	pan.	400	3,899	9,747	90,250	736	6,815
1947—48									
Juil.....	S	Hp	pan.	322	789	2,451	14,945	44	268
Août	SC	Hp	pan.	507	1,834	3,617	23,641	72	471
Sept.....	S	Hp	pan.	645	4,547	7,050	45,192	125	801
Sept.....	C	Hp	pan.	162	577	3,563	22,840	87	558
Oct.....	C	Hp	pan.	645	4,835	7,496	56,788	129	977
Nov.	C	Hp	pan.	160	1,329	8,304	65,905	131	1,040
Nov.	M	Hp	pan.	119	454	3,816	34,378	62	559
Déc.....	M	Hp	pan.	131	863	6,588	59,351	142	1,279
Déc.....	M	Hg	pan.	677	1,363	2,013	17,814	217	1,920
Janv.....	M	Hg	pan.	1,057	4,310	4,077	34,551	386	3,271
Févr.....	M	Hg	pan.	413	1,027	2,487	22,009	280	2,478
Mars	M	Hg	pan.	43	51	1,195	10,575	159	1,407
1948—49									
Juil.....	S	Hp	pan.	134	403	3,004	17,068	49	278
Août.....	SC	Hp	pan.	683	2,587	3,788	22,958	75	455
Sept.....	SC	Hp	pan.	771	6,072	7,875	49,528	143	899
Oct.....	CM	Hp	pan.	365	3,040	8,328	62,149	125	933
Nov.	C	Hp	pan.	113	686	6,069	47,787	93	732
Nov.	M	Hp	pan.	278	1,441	5,184	45,876	159	1,407
Nov.	M	Hg	pan.	50	23	451	3,855	79	675
Déc.....	M	Hp	pan.	37	34	932	8,321	26	232
Déc.....	M	Hg	pan.	1,454	2,396	1,648	14,085	168	1,436
Janv.....	M	Hg	pan.	1,690	6,109	3,615	32,568	362	3,261
Févr.....	M	Hg	pan.	582	995	1,709	15,396	212	1,910
1949—50									
Juil.....	S	Hp	pan.	108	808	7,480	42,500	94	534
Août	S	Hp	pan.	309	3,298	10,675	64,697	121	733
Sept.....	S	Hp	pan.	191	1,751	9,169	57,306	88	550
Sept.....	C	Hp	pan.	161	1,453	9,024	57,846	112	718
Oct.....	C	Hp	pan.	197	1,637	8,311	56,537	156	1,061
Nov.	C	Hp	pan.	63	302	4,793	36,588	125	954
Nov.	M	Hp	pan.	99	285	2,882	24,017	79	658
Déc.....	M	Hg	pan.	474	431	908	8,902	119	1,167
Janv.....	M	Hg	pan.	981	1,797	1,832	18,505	340	3,434
Févr.....	M	Hg	pan.	274	199	725	7,398	157	1,602
1950—51									
Juil.....	S	Hp	pan.	36	152	4,219	24,109	35	200
Juil.....	C	Hp	pan.	9	35	3,933	22,347	23	131
Août	S	Hp	pan.	237	1,219	5,144	31,366	78	476
Août	C	Hp	pan.	87	688	7,902	45,414	113	649
Sept.....	C	Hp	pan.	441	3,385	7,676	50,170	168	1,098

Tableau 3 (suite).

Année et Mois	Détail			Nombre de jours de pêche	Poids total débarqué (tonnes)	Prise moyenne par jour de mer		Prise moyenne par 100 HP×C.V.	
						Kg.	Individus	Kg.	Individus
Oct.	S	Hp	pan.	20	20	985	65,667	14	93
Oct.	C	Hp	pan.	257	1,721	6,698	45,877	171	1,171
Oct.	M	Hp	pan.	13	34	2,589	18,493	117	836
Nov.	C	Hp	pan.	28	52	1,871	14,174	46	348
Nov.	M	Hp	pan.	155	236	1,525	12,603	59	488
Déc.	M	Hp	pan.	9	12	1,383	11,430	59	488
Déc.	M	Hg	pan.	114	655	5,743	52,209	718	6,527
Janv.	M	Hg	pan.	227	1,052	4,632	43,290	460	4,299
1951—52									
Juil.	S	Hp	pan.	55	226	4,101	21,584	45	237
Août	S	Hp	pan.	138	1,090	7,898	44,123	81	453
Août	C	Hp	pan.	110	533	4,848	32,537	82	550
Sept.	S	Hp	pan.	43	345	8,024	46,382	80	462
Sept.	C	Hp	pan.	207	1,443	6,973	46,799	122	819
Oct.	C	Hp	pan.	184	1,502	8,164	53,013	156	1,013
Nov.	C	Hp	pan.	74	228	3,085	22,355	56	406
Nov.	M	Hp	pan.	245	340	1,390	11,032	55	437
Déc.	M	Hp	pan.	96	86	895	7,160	52	416
Déc.	M	Hg	pan.	100	406	4,065	35,658	421	3,693
Déc.	M	Hg	pél.	12	93	7,717	67,693	897	7,868
Janv.	M	Hg	pan.	98	434	4,425	40,596	446	4,092
Janv.	M	Hg	pél.	76	577	7,596	69,688	816	7,486
Févr.	M	Hg	pan.	27	89	3,314	31,865	348	3,346
Févr.	M	Hg	pél.	266	1,875	7,050	67,788	629	6,048
1952—53									
Juil.	S	Hp	pan.	127	763	6,006	27,935	75	349
Août	S	Hp	pan.	193	1,159	6,007	29,446	80	392
Août	C	Hp	pan.	64	288	4,503	28,321	72	453
Sept.	C	Hp	pan.	186	1,686	9,064	57,732	146	930
Oct.	C	Hp	pan.	196	1,283	6,545	38,958	129	768
Oct.	M	Hp	pan.	19	58	3,076	20,237	102	671
Nov.	C	Hp	pan.	18	57	3,181	21,493	37	250
Nov.	M	Hp	pan.	504	1,093	2,169	16,557	114	870
Déc.	M	Hp	pan.	24	141	5,857	44,710	167	1,275
Déc.	M	Hg	pél.	476	2,640	5,547	48,235	552	4,800
Janv.	M	Hg	pél.	645	3,489	5,410	47,043	496	4,313
1953—54									
Juil.	S	Hp	pan.	63	334	5,307	24,233	47	215
Août	S	Hp	pan.	160	1,303	8,147	39,168	84	404
Août	C	Hp	pan.	38	360	9,479	50,690	131	701
Sept.	C	Hp	pan.	245	2,448	9,993	59,482	135	804
Oct.	C	Hp	pan.	246	2,436	9,903	59,657	137	825
Oct.	M	Hp	pan.	3	37	12,417	77,606	230	1,438
Oct.	M	Hp	pél.	12	24	2,025	12,656	529	3,306
Nov.	M	Hp	pan.	70	167	2,392	15,333	139	891
Nov.	M	Hp	pél.	541	2,418	4,469	28,647	309	1,981
Nov.	M	Hg	pél.	25	17	685	5,708	160	1,333
Déc.	M	Hp	pan.	21	347	16,502	105,782	211	1,353
Déc.	M	Hp	pél.	8	24	2,938	18,833	478	3,064
Déc.	M	Hg	pél.	458	2,433	5,313	44,275	468	3,900
Janv.	M	Hg	pél.	410	3,752	9,150	75,620	947	7,826
Févr.	M	Hg	pél.	311	3,968	12,758	115,982	1,199	10,900
Mars	M	Hg	pél.	2	4	1,900	17,273	132	1,200
1954—55									
Juil.	S	Hp	pan.	44	145	3,393	18,193	31	171
Août	S	Hp	pan.	58	550	9,487	55,806	74	435
Août	C	Hp	pan.	13	86	6,623	38,506	64	372
Sept.	S	Hp	pan.	5	99	19,780	119,157	121	729
Sept.	C	Hp	pan.	89	697	7,829	47,448	106	642
Oct.	C	Hp	pan.	123	698	5,676	35,475	113	706
Oct.	M	Hp	pél.	66	234	3,552	23,216	180	1,176

Tableau 3 (suite).

Année et Mois	Détail			Nombre de jours de pêche	Poids tatal débarqué (tonnes)	Prise moyenne par jour de mer		Prise moyenne par 100 HP × C.V.	
						Kg.	Individus	Kg.	Individus
1954—55									
Nov.	M	Hp	pan.	7	191	27,231	198,766	95	693
Nov.	M	Hp	pél.	360	1,669	4,637	33,847	166	1,212
Déc.....	M	Hp	pél.	2	8	4,225	31,066	45	331
Déc.....	M	Hg	pél.	430	2,179	5,068	40,871	430	3,468
Janv.....	M	Hg	pél.	588	4,550	7,737	66,698	642	5,534
Févr.....	M	Hg	pél.	304	1,248	4,105	31,822	354	2.744
1955—56									
Juil	S	Hp	pan.	18	86	4,772	23,860	37	185
Août	S	Hp	pan.	23	146	6,359	33,824	74	394
Août	C	Hp	pan.	21	139	6,636	34,743	64	335
Sept.....	C	Hp	pan.	39	166	4,251	21,579	95	482
Oct.....	S	Hp	pan.	8	11	1,419	7,840	14	77
Oct.....	C	Hp	pan.	116	508	4,383	25,335	102	590
Oct.....	M	Hp	pél.	60	443	7,382	43,170	447	2,614
Nov.	M	Hp	pél.	1,115	5,108	4,581	29,178	390	2,484
Déc.....	M	Hp	pan.	38	172	4,516	28,403	188	1,182
Déc.....	M	Hp	pél.	635	2,382	3,752	23,597	302	1,899
Déc.....	M	Hg	pél.	158	367	2,324	18,016	180	1,395
Janv.....	M	Hg	pél.	514	2,619	5,096	38,316	381	2,865
Févr.....	M	Hg	pél.	182	608	3,342	28,564	246	2,103

Résumé

Les concentrations de harengs exploitées par les pêcheurs belges dans la région septentrionale de la Mer du Nord, en juillet et août, contiennent ± 10 % de Harengs de Printemps et ± 90 % de Harengs d'Automne. Dans les Harengs d'Automne on observe des Harengs du Dogger Bank et des Harengs des Downs, ces derniers étant faiblement représentés.

Dans les pêches provenant de la région centrale (septembre-octobre) les Harengs de Printemps semblent faire totalement défaut, tandis que l'on y retrouve les Harengs du Dogger Bank et ceux des Downs, les premiers toujours en majeure partie.

Dans la région méridionale (novembre-février) on retrouve encore les deux populations précités mais ici les Harengs des Downs dominent. A partir de décembre, lorsque 90 % des harengs montrent le stade guais (VII—VIII—II) les Harengs du Dogger Bank paraissent en grande partie éliminés et totalement à partir de janvier.